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OH-58D Kiowa Warrior

Walk Around No. 50

Color Series

Floyd S. Werner Jr.

Squadron Signal Publications

Don Greer 2007

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Cover paintings and illustrations by Don Greer

Bell's OH-58D came about as a requirement placed on Army Aviation to provide a digital platform to aid new artillery. Originally unarmed as part of the Army Helicopter Improvement Program (AHIP), the OH-58D took to the air for its first flight in 1983. Using only the basic structure of the OH-58C Kiowa, the OH-58D was actually a completely new helicopter, featuring a four-blade main rotor, a more powerful Allison 250-C30 engine, multifunction display, and a Mast Mounted Sight (MMS).

The MMS was the basis for the upgrade program. The MMS contained a Television System (TVS), Thermal Imagining System (TIS), and Laser Rangefinder/Designator (LRF/D). The helicopter was so successful the Army decided to arm it. The Kiowa Warrior's armament consisted of two hard points that could hold either a .50-caliber machine gun, seven-shot 2.75-inch Folding Fin Aircraft Rocket pods, an Air-to-Air Stinger (ATAS), or Hellfire missiles.

Developed in the shadow of the Light Utility Helicopter/Comanche program, the Warrior has always been looked at as an "interim" helicopter. It was first-blooded in Operation Prime Chance in 1987 against Iranian gunboats. Continuous upgrades have been made, which include squatting deployment landing gear, folding horizontal tail, folding blades, and upgraded digital communications, making the Warrior highly deployable and lethal.

Based on the success of the Prime Chance aircraft, the Army elected to expand production as the Comanche program slipped further behind schedule. Deployed again in 1991 during Operation Desert Storm, the Kiowa Warrior distinguished itself flying from ships and ground bases to support the ground offensive. Warriors have also been deployed to Somalia, Bosnia, and Kosovo for peacekeeping duties. The Kiowa Warrior really came into its own during Operation Iraqi Freedom and distinguished itself in counterinsurgency battles.

With the cancellation of the Comanche program, the Kiowa Warrior will soldier on until the Armed Reconnaissance Helicopter program comes online. As of 2007, the "interim" helicopter was still serving, more than 20 years after its first flight.

Dedication

This book is dedicated to the soldiers who have flown and maintained the Kiowa Warrior, to those men and women I had the pleasure to serve with in my 21 years in the U.S. Army, and to the ones who serve today in our armed forces. This book is especially dedicated to those soldiers from my past units who paid the ultimate price for freedom, Chief Warrant Officer Stephen Wells (KIA 25 February 2004) and Maj. Matt Worrell (KIA 14 May 2006), and those severely wounded, such as Chief Warrant Officer Cody Sharp. These men, who defend freedom daily and endure countless hardships in a selfless manner, are true American heroes. These guys were and always will be my friends. We owe them our freedom. Don't take these sacrifices for granted: Freedom isn't free.

This book is also dedicated to my wife, Yvonne, and our three daughters, Angel, Athena, and Alison. For 21 years, these beloved camp followers moved around the world, changed schools, made new friends everywhere we went, and never once complained about it. They always looked forward to the new challenges of a new duty assignment and faced them head-on. How can a man ask for anything more out of a family? Over the last 25 years, Yvonne has supported everything I've done in my military and civilian life. Without her help, I shudder to think of what would have become of me. She is everything a man could want in a wife, and for that and for her love, support, patience, and dedication, I thank her.

Acknowledgements

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Front cover: An OH-58D(R) trains at the Korea Training Center.

Back cover: An OH-58D(R) flies near Yuma Proving Ground in Arizona.

Title page: Hovering over a symbol of Saddam Hussein's Iraq, a Kiowa Warrior from D Troop, 1st Squadron, 1st Cavalry Regiment, 1st Armored Division, shows the bold resolve of the American soldier.

Designed for the AHIP, the third prototype of the Kiowa Warrior shows a slightly different look than the OH-58C, with the addition of a McDonnell Douglas MMS and the four-blade main rotor system. (*George Prosnik*)

Prototype No. 5 is the final test version of the Kiowa Warrior. The helicopter has a test probe in front of the nose. The aircraft was originally designed as an artillery spotter, so it has no provisions for weapons. The back doors still had clear Plexiglas, even though the craft had no room for passengers. (*DoD*)

These aircraft from D Troop, 1st Squadron, 1st Cavalry Regiment, 1st Armored Division, were being prepared for shipment back to the United States from Kaposvar, Hungary, in 1996. With the last of the unarmed Kiowa Warriors, D Troop flew in support of the Implementation Force (IFOR) when the Dayton Peace Accords were signed in 1995. (*George Prosnik*)

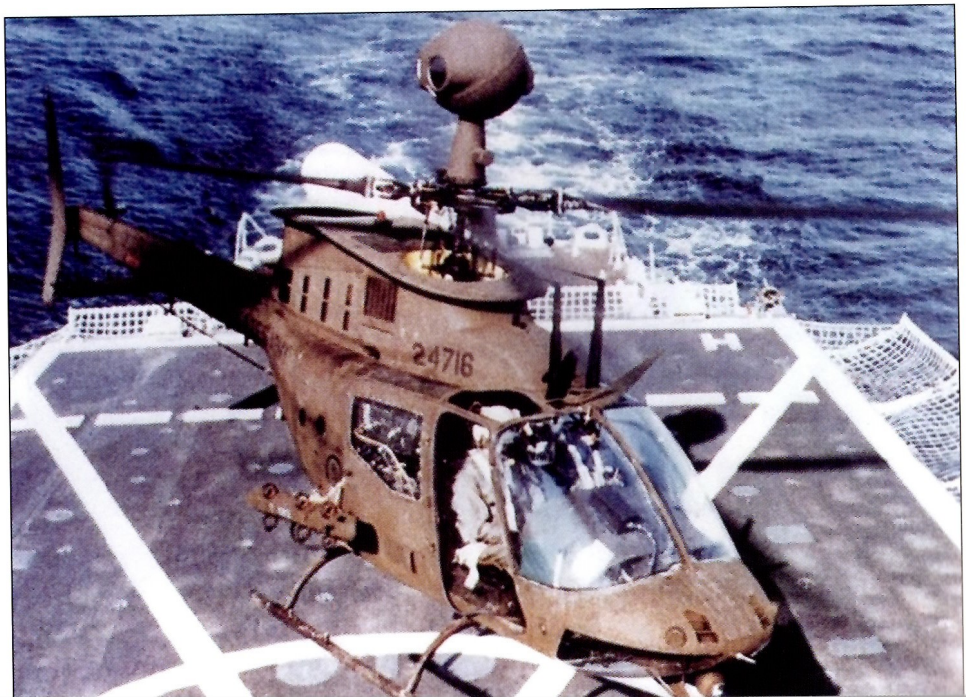
D Troop Kiowa Warriors sit on a tarmac awaiting transportation by a C-5 Galaxy at Taszar, Hungary. These Warriors were the first aircraft to fly missions over war-torn Bosnia in December 1995. (*DoD*)

Stationed at Budingen, Germany, in 1994, this aircraft (serial number 82-4733) represents the final operational variant of the unarmed Warrior. It was assigned to the divisional cavalry squadron. Each division within the Army had a cavalry squadron that included at least one troop of Warriors. (*George Prosnik*)

The stealth version of the Kiowa Warrior had a more pointed nose than a normal production aircraft. Stealth modifications were eventually deemed unnecessary, but aircraft already modified continued in their current configuration. (*Wings, Wheels & Armor*)

The testing of stealth technology was integrated into the Kiowa at an early stage. Its small design and quiet four-blade main rotor allowed it to get close to the enemy before being detected. The main rotor hub, controls, and the front of the aircraft were fitted with radar-absorbing material. (*Wings, Wheels & Armor*)

The need for a small, light scout/attack helicopter to counter Iranian gunboats in 1987 led to the development of 15 armed Kiowa Warriors. The aircraft were to operate during Operation Prime Chance as Task Force 118 and were deployed to the Persian Gulf in early 1988. (*George Prosnik*)



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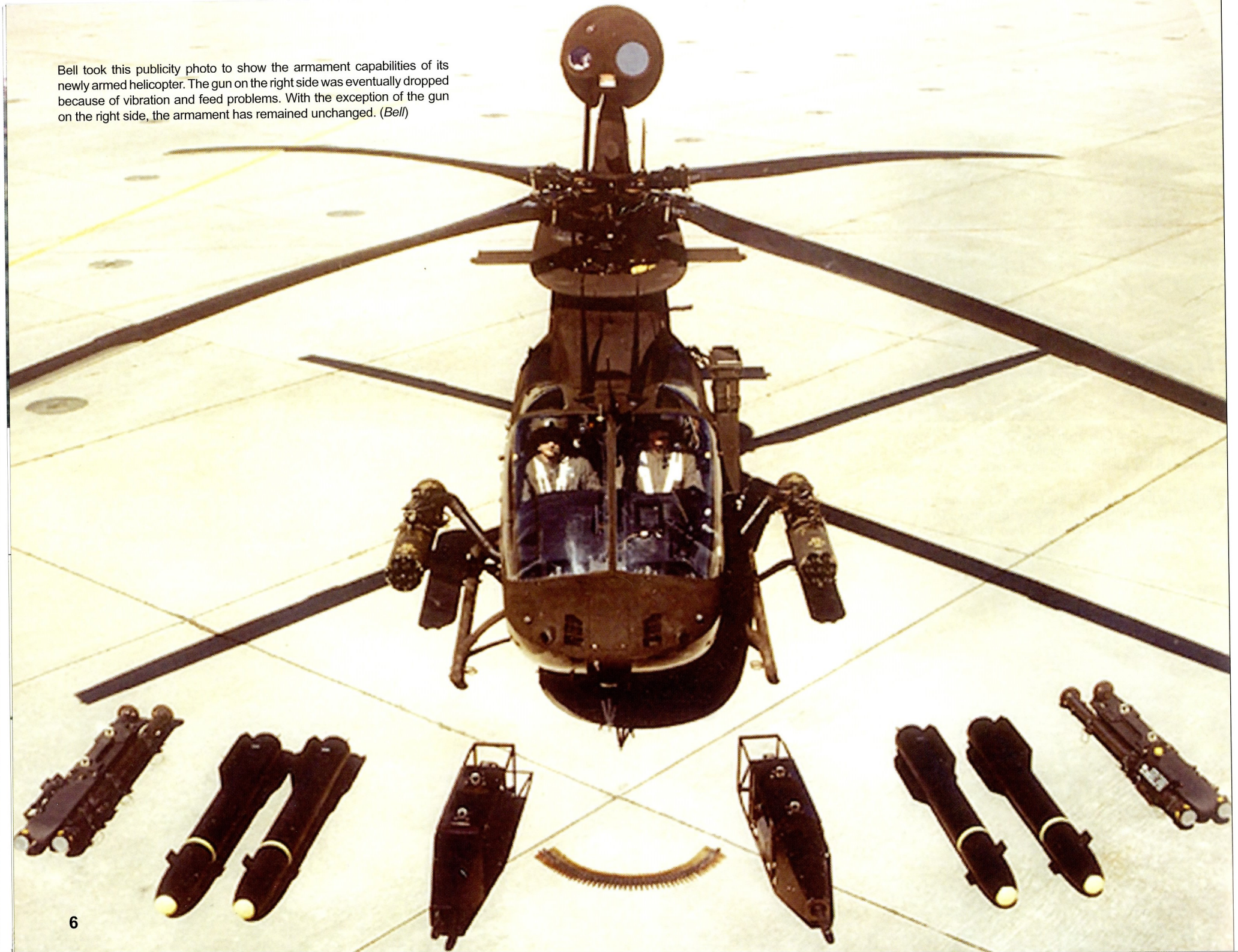
The highly classified Operation Prime Chance mission resulted in each aircraft being built with "strap-on" equipment, including armament and navigation gear. Prime Chance aircraft added 15 black boxes, four antennas, and 11 cockpit control/display units to the basic AHIP airframe. (*William Roberts*)

The tight confines of frigates called for excellent flying skills, especially while using night vision goggles (NVGs). Besides adding weapon systems, the transmission was uprated, and the maximum gross weight was increased to 5,500 pounds. (*Mark Vanderweyden*)

Prompted by the success of Task Force 118 and the armed Warriors, the Army elected to convert all of its AHIP craft to the armed Kiowa Warrior. Bell produced a uniquely decorated demonstrator version of the Warrior and unveiled it to the public. (*Mark Vanderweyden*)

Besides the obvious full-color Kiowa Indian head, the new Warrior featured gold-tinted windscreens, gloss black paint, stealth modifications, and rapid deployment gear. (*William Roberts*)



Bell took this publicity photo to show the armament capabilities of its newly armed helicopter. The gun on the right side was eventually dropped because of vibration and feed problems. With the exception of the gun on the right side, the armament has remained unchanged. (*Bell*)

Operation Desert Storm began before the Warrior's armament systems could be installed. The unarmed Warrior went to war with the U.S. Army as scouts and artillery spotters. This Warrior is seen in Saudi Arabia before hostilities. Warrior units maintained an operational readiness rate of 92 percent while flying nearly 9,000 hours. (*Wings, Wheels & Armor*)

During Desert Storm, the 3rd Infantry Division from the U.S. Army-Europe painted its aircraft with latex house paint over the chemical agent-resistant paint. The colors were brown and white and mixed together to produce a light tan color. This aircraft, assigned to H Company, 4th Brigade, 3rd Aviation Regiment, has only one FM antenna on the roof. (*William Roberts*)

The full span right door is a carryover from the OH-58A/C. Various mounts have been added to the airframe to allow armament to be mounted and stowed. With a fuel capacity of 112 gallons of JP-4, the OH-58D could fly for just longer than 2½ hours. (*Jonathan Bernstein*)

The door shows the various panels that were required to mount one of the four armament systems the OH-58D could carry. The connector below the door is for the power and controlling input. The step on the right was provided to allow the pilot access to the upper cowling area. (*Jonathan Bernstein*)

The prototype for the OH-58D is on display at the U.S. Army Aviation Museum at Ft. Rucker, Alabama. The helicopter is in disrepair but is open to the public. It is painted in the standard Federal Standard (FS) 34031. At some point, the back door window was painted over, but even well after Desert Storm, the back windows were still clear. (*Jonathan Bernstein*)

Swirl tubes on the engine inlet allowed filtered air to reach the engine. The swirl tubes swirl the incoming air into circles, causing the heavier particles to be pulled to the outside. The air is then blown out of the particle separator, which is now faired over. The clean air is then used by the engine. The engine cowling cooling fins are the same style as on an OH-58C. (*Jonathan Bernstein*)

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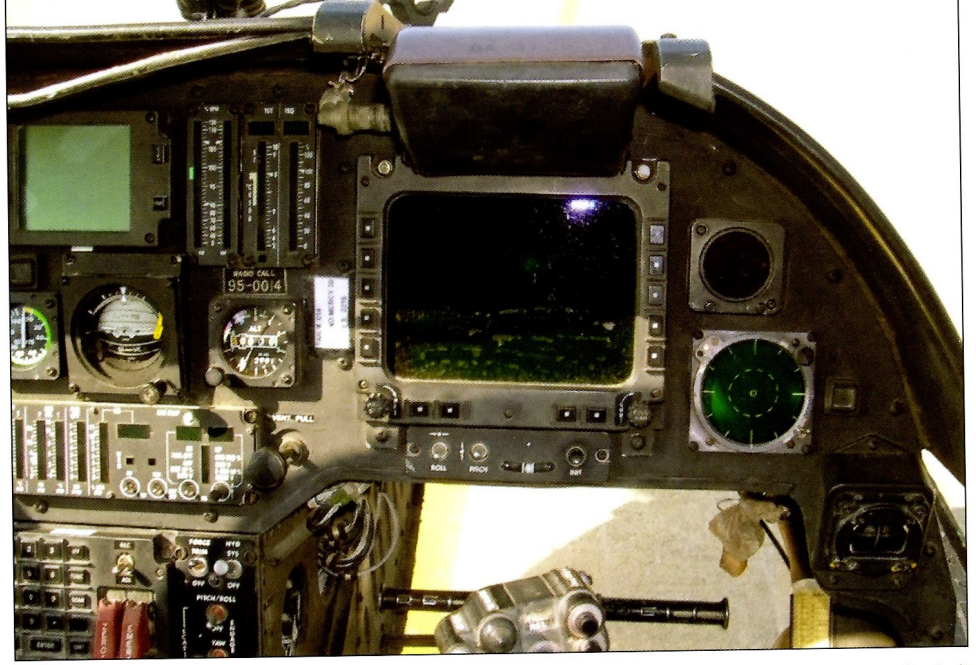
The tan color and inverted "V" markings help identify this Warrior as belonging to the coalition forces in Operation Desert Storm. This aircraft, assigned to H Company, 4th Brigade, 3rd Aviation Regiment, 3rd Infantry Division, was photographed in Germany after hostilities in 1991.

An Auxiliary Ground Power Unit melts ice off the main rotor blades of the last operational unarmed Kiowa Warriors of D Troop at Budingen Airfield in Germany in December 1995 in preparation for deployment to Bosnia. With their flat black back doors and IFOR markings, the Warriors were instrumental in the peacekeeping operations in Bosnia.

Unarmed Warriors still have a place at the "schoolhouse," Ft. Rucker. This aircraft has large identifying "buzz" numbers. The pilots have placed their helmets on the hooks inside the cockpit. These aircraft are used for aircraft transition training and for maintenance test flight training. They lack aircraft mission equipment in order to keep weight down. (*William Roberts*)

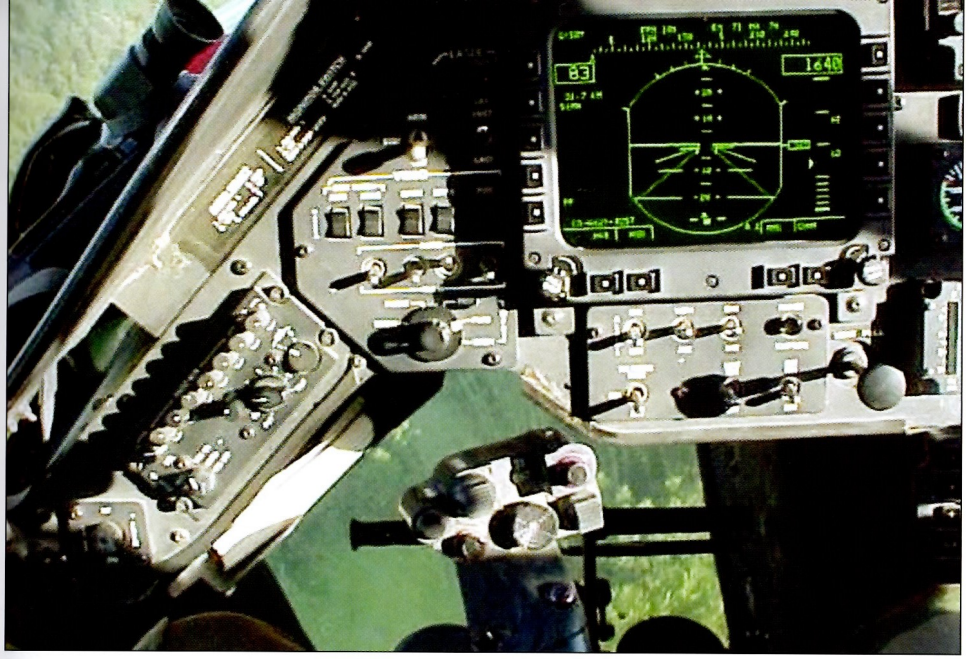
Hovering near its predecessor, this OH-58D is assigned to the 2nd Armored Cavalry Regiment. The window to the back seat has openings used to help keep components cool. On the OH-58C, the openings were used to cool passengers; but, passengers became a thing of the past with the addition of electronics components. *(William Roberts*)

The Warrior has the first all-glass cockpit on a U.S. Army helicopter. The center of the dash panel is topped by the Remote Frequency Display, which can show five frequencies for easy selection. Analog instruments are included as backups in case of digital failure. The engine conditions are displayed digitally on the Multiparameter Display.



The cockpit of the OH-58D(R) is finished in flat black overall. This aids NVG operations. The Cockpit Airbag System (CABS) is mounted over the MFD. An APR-39 indicator with a green clock-type face gives the pilot an indication of radar-guided missiles. The digital clock is above the APR-39 indicator.

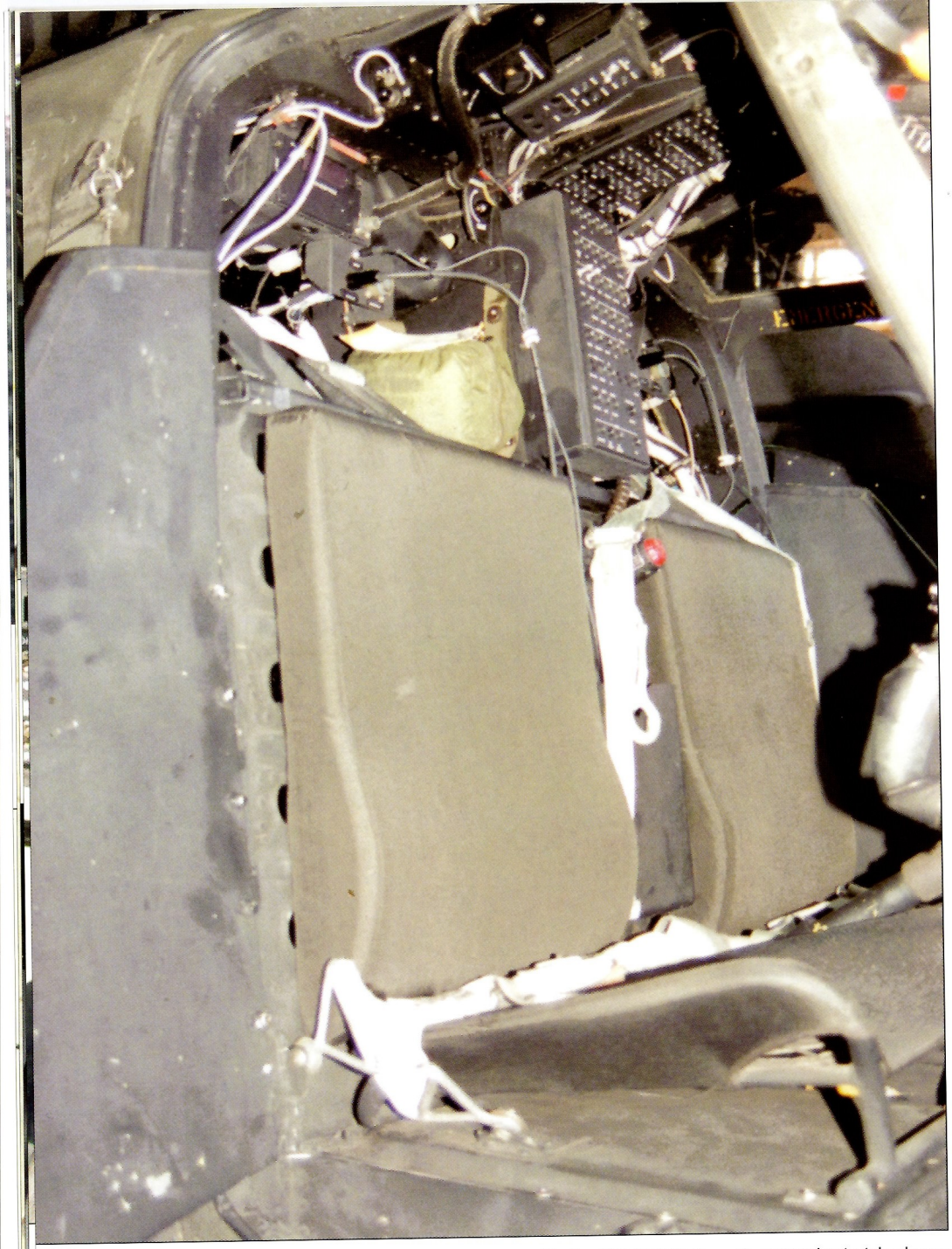
The co-pilot/gunner's side of the cockpit is uniquely suited to control the weapon systems. The MFD is the same as the pilot's. The MMS control panel is located to the left of the MFD. The co-pilot also has a CABS installed in the instrument panel coaming. Below the MFD is the co-pilot's auxiliary control panel.



A typical MFD readout is shown on this co-pilot/gunner MFD. The display is green so it will not interfere with NVG operations. When the MMS is turned on, the video is displayed behind the symbology, allowing the gunner to track the target while sending digital messages. The aircraft is flying at 83 knots and is at 1,640 feet. (*www.kiowapilots.com*)

The red switch at the bottom center of the center console differentiates the earlier OH-58D(I) instrument panel from the panel in the OH-58D(R). This switch is marked “digital” and “analog” and controls the fuel control metering.

The Multifunction Keyboard (MFK) allows the crew to input data into digital messages. Two red selector switches are on the MFK. One zeroizes, which deletes all data from the communication equipment, and the other changes all the radios over to the emergency frequencies.



Early crew seats were unchanged from the ones used in the OH-58A/C. A mesh screen is stretched over the seat frame, and the seat backs are padded. These pads are occasionally removed in combat to allow more room for the crew's chicken plate body armor. The green item behind the seat is a first aid kit.

The overall layout of the instrument panel can be seen from inside of the co-pilot/gunner's cockpit. The cloth seats are the latest type fitted to the Kiowa Warrior. The Bell logo is on both sets of pedals.

This Warrior has mesh stretched over its seats. The co-pilot/gunner's cyclic can be locked out by a lever at the bottom. The cyclic is the control stick in a helicopter. It moves the aircraft left, right, forward, and backward. The co-pilot/gunner's and pilot's cyclics are different. The co-pilot/gunner's is designed to control the MMS and designate targets, and the pilot's is for control of the helicopter and firing the weapons systems.

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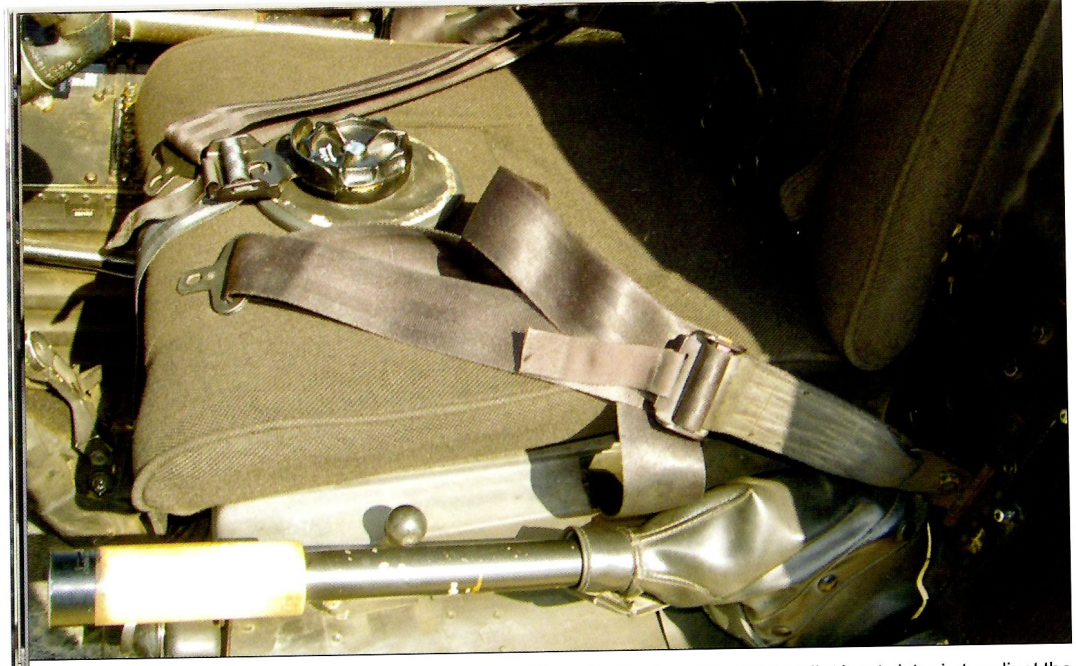
New shoulder harnesses are light blue but quickly fade to a dirty off-white in use. Most seat covers are black; however, a few are still olive drab. They both lace up underneath the seat for comfort. The lever on the left of the seat is the collective, which is the up-down lever for the rotor controls.

Around 1999, new seats were introduced to the Warrior. These new seats are padded and incorporate a five-point harness. The new harness is black with a fur lining to protect the crew members' necks. The lining functions the same as a silk scarf did in World War I. The seats are made of fire-retardant memory foam.

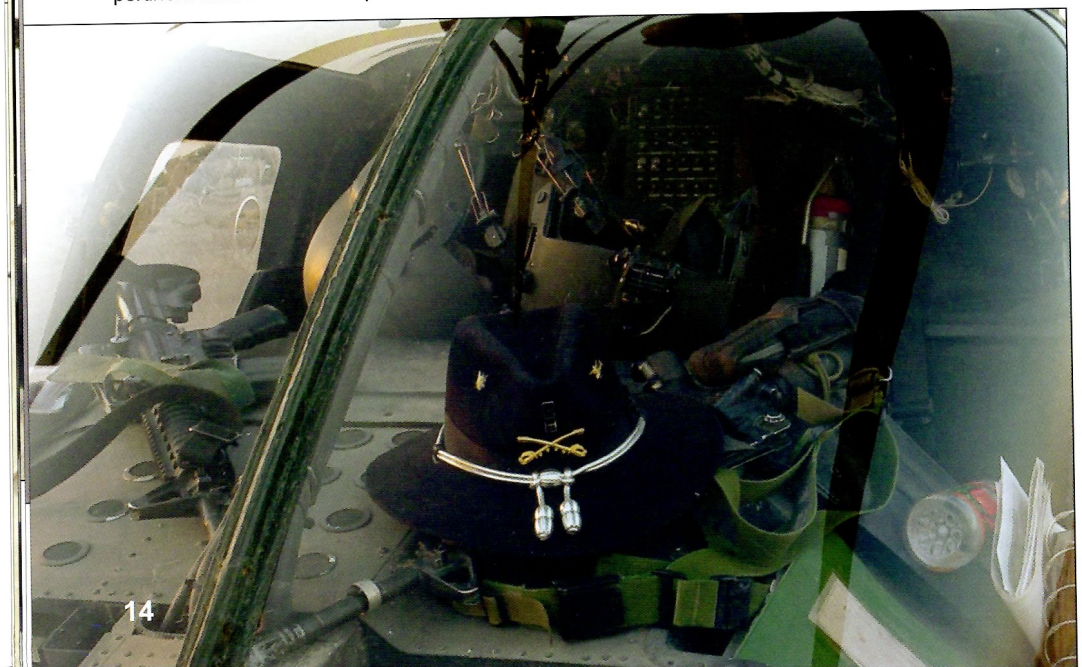


The Warrior has a five-point restraint system. The collective head for the co-pilot is a twist grip to adjust the engine rpm. It can be removed when flying with nonrated pilots, but that is not the normal configuration. The end is made of cork and, depending on how old it is, can range from light tan to burnt umber.

The CABS and the associated stiffeners are visible through the windscreen. Also visible are the mounts for the CAR-15s. This simple yet effective system allows crew members to have a rifle in the event of being shot down. The large cable that travels down the center support is a cover for the electrical wiring from the circuit breaker panel to the appropriate systems.

The ever-present Stetson represents the cavalry tradition and is often carried on deployments. This aircraft has had a modification to the glare shield to carry two CAR-15 rifles. The pilot's holster, carrying his M9 Beretta pistol, is also laying on the dash. Two HGU-56 flight helmets hang from the center console out of the way. The light-green book is the aircraft logbook and is carried on every flight. It contains all the pertinent data to inform the pilot of the helicopter's operational condition. (*Mark Martin*)

In this view through the windscreen, the pilot's back cushion on the left has been removed. While a pilot is wearing chicken plate armor, he cannot feel the cushion since the armor is made of a ceramic material, rendering the cushion useless. The center circuit breaker panel protects the aircraft's electrical systems. The circuit breaker works like a household fuse. When too much current is drawn, the circuit breaker pops and protects the system.



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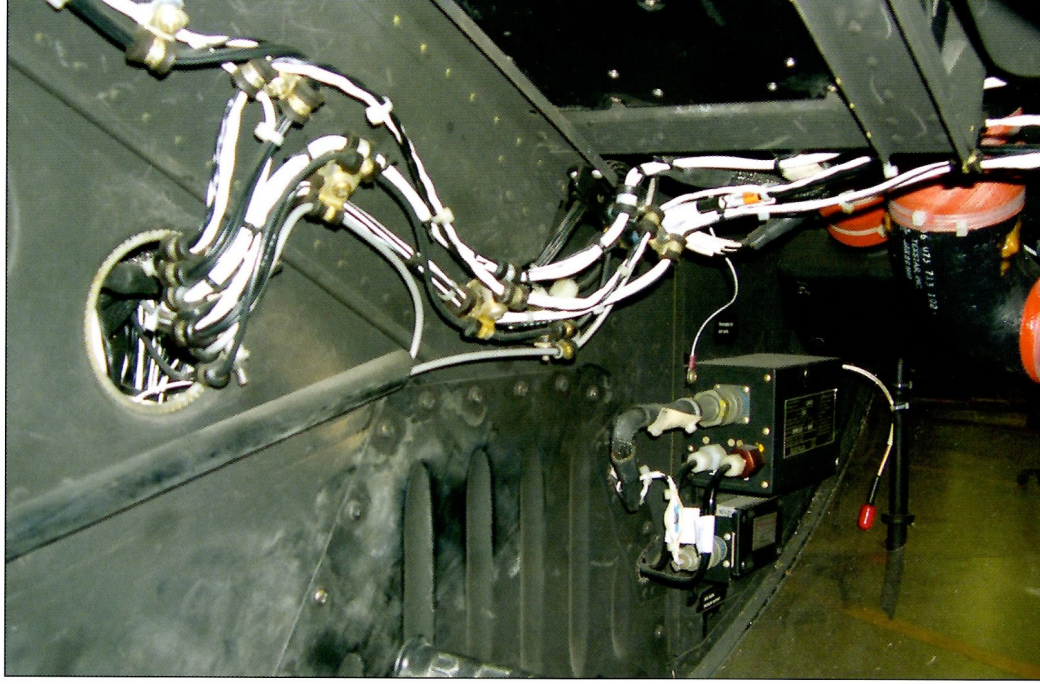
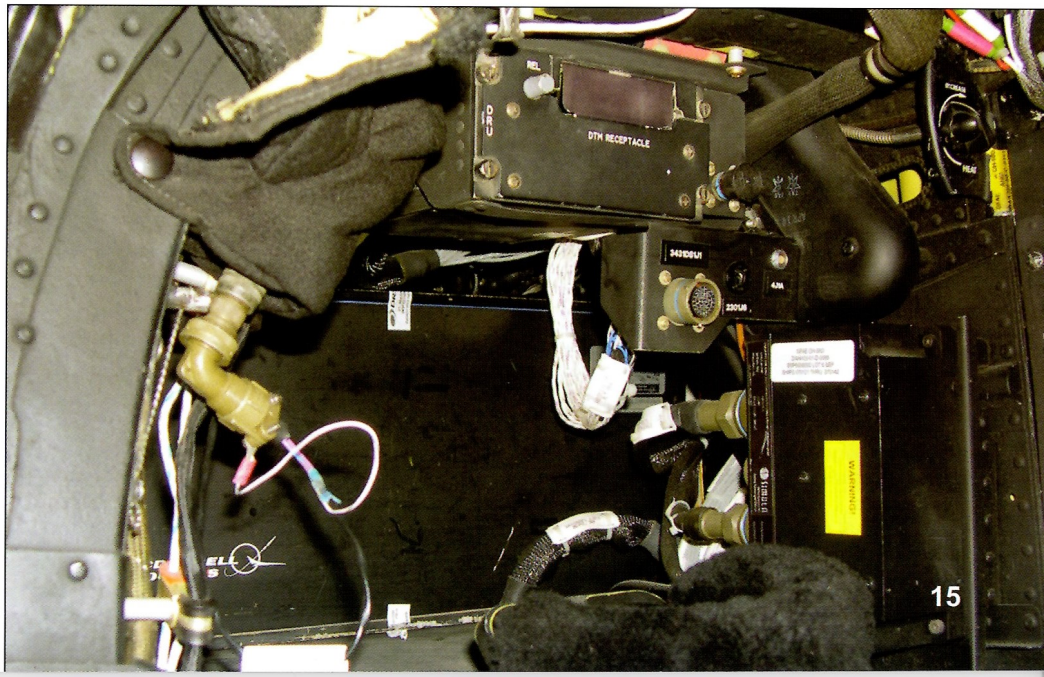
The upper circuit panel and the associated wiring takes up a considerable portion of the center of the cockpit. The orange handle is the emergency fuel shutoff valve used to cut fuel flow to the engine. The blue light is used for cockpit illumination and is NVG-compatible.

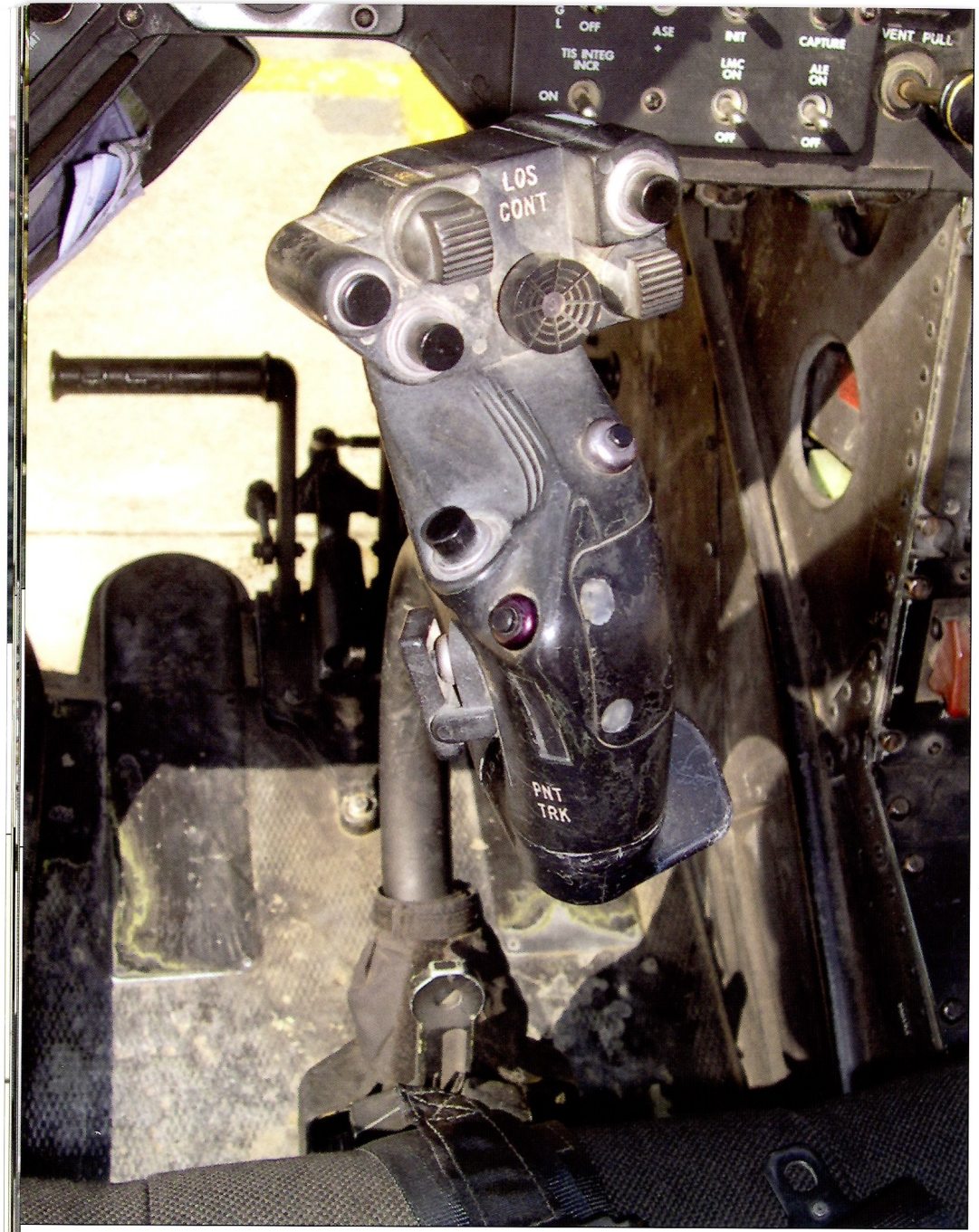
The CABS is attached to the door frame on both sides of the cockpit and includes a canvas cover. The purpose of this particular piece of the CABS is to prevent head injury. When accompanied with the console-mounted air bags, the crew becomes encapsulated in the cockpit during a crash. The bags deflate immediately after the crash.



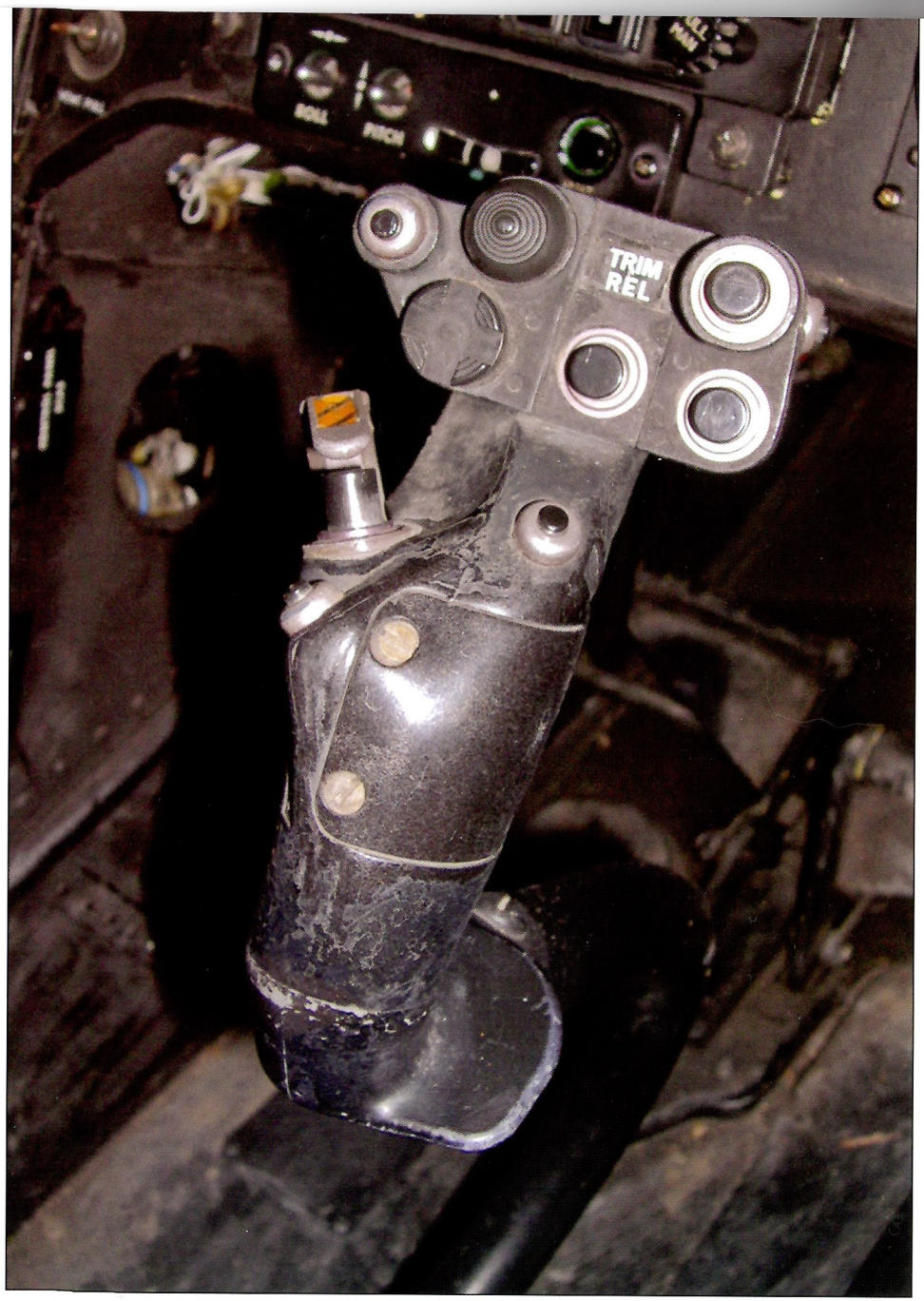
Part of the pitot static system for the airspeed indicator and various electrical cables from the instrument panel are inside the pilot's side of the cockpit under the instrument panel. The cables are routed up the windscreen to the Improved Master Controller Processor Units (IMCPU) behind the seats.

A view behind the pilot's seat shows the Improved Data Modem (IDM) used on the R model OH-58D. Before a mission, the data, including graphics, weapons load, and frequencies, is uploaded, taken to the aircraft, and plugged in. The data can then be accessed by the crew. This ensures that the entire unit has the same information. Below the IDM is the connector for the M-43 gas mask.





The co-pilot/gunner's cyclic has the necessary switches to track, laser designate, and range find with the MMS. It also has a switch to communicate inside and outside the cockpit. It can be locked out, which disengages it from the flight control of the helicopters. The co-pilot's stick is not normally locked out, because that setting has led to a crash. This means the gunner has to be light-handed on the controls while the pilot is flying the helicopter.



The pilot's cyclic head has the controls to fly the aircraft, communicate, and fire the weapon systems. The pilot and co-pilot/gunner must operate as a crew to be successful since they rely on each other to engage enemy targets.

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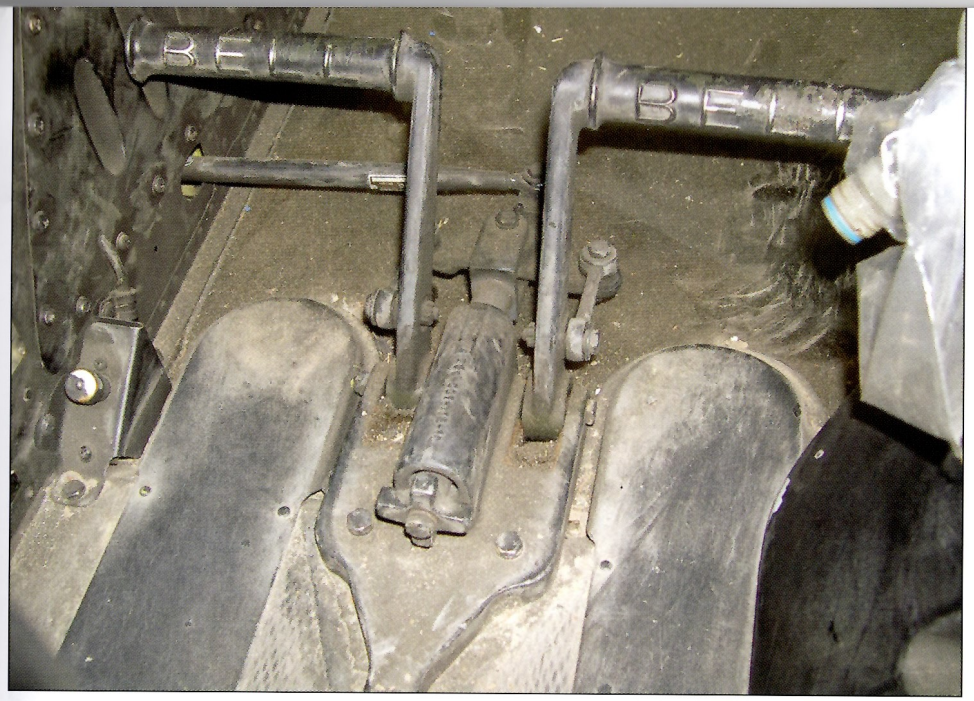


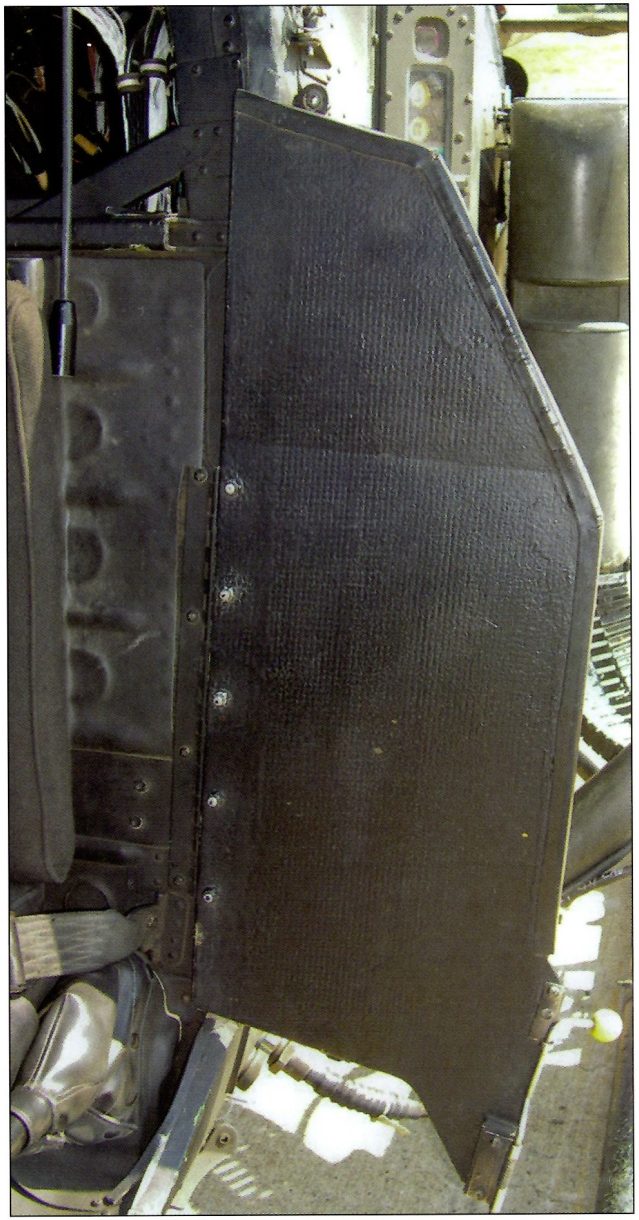
The control pedals have the Bell logo on them. This has been a tradition with Bell products since Vietnam. The pedals are the same on both sides of the cockpit. They can be adjusted out and in. The control pedals keep the helicopter in trim while in flight. While hovering, they turn the nose left and right. Stepping on the left pedal turns the nose of the helicopter left.

The collective head on the pilot's side contains the switches necessary to start the helicopter, control the searchlight, trim the helicopter, and control rotor rpm. The Warrior is designed so pilots don't have to take their hands off the controls while flying. The theory is that pilots will concentrate on flying. The axiom is "Never stop flying the helicopter" — aviate, navigate, and communicate; shoot, move, and communicate.

Patrolling over Persian Gulf oil rigs, a pilot searches for Iranian gun boats. The handle with the yellow ball on the end is used to release the door in case of emergency. The bolts hanging down in front of the pilot are for mounting the Pilot Display Unit (PDU), which is fitted to fire the ATAS. (*William Roberts*)

Clear air inlets let fresh air into the cockpit. The Kiowa Warrior has only “240” air conditioning — two doors off and 40 knots airspeed. The yellow emergency release handle is just inside the windscreen. A sheet metal panel is attached to the back of the door to “lock” it.

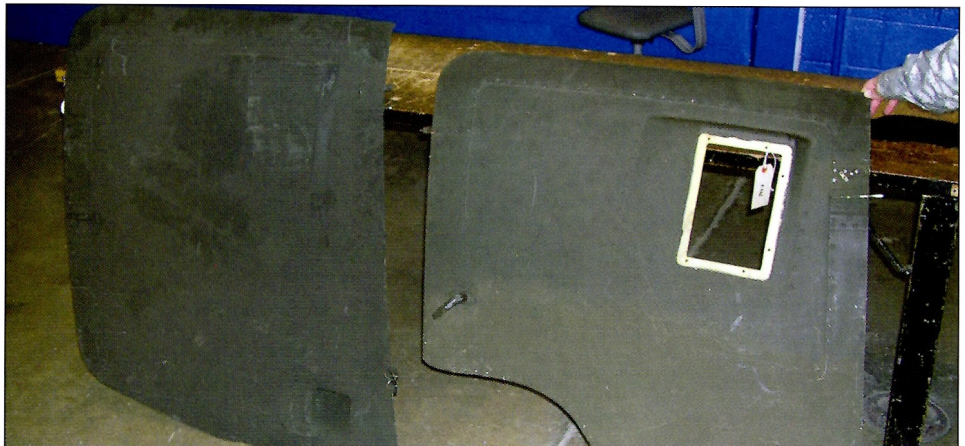
The inside of the crew door has a twist handle to open in. These doors are frequently left off during combat missions because they restrict visibility. They can be jettisoned in an emergency by pulling the yellow handle on the door frame, which pulls up a rod that holds the door on its hinges. The door will then either fall off or can be pushed off. The two-vent windows are for cockpit ventilation, but they provide little comfort in the desert heat.



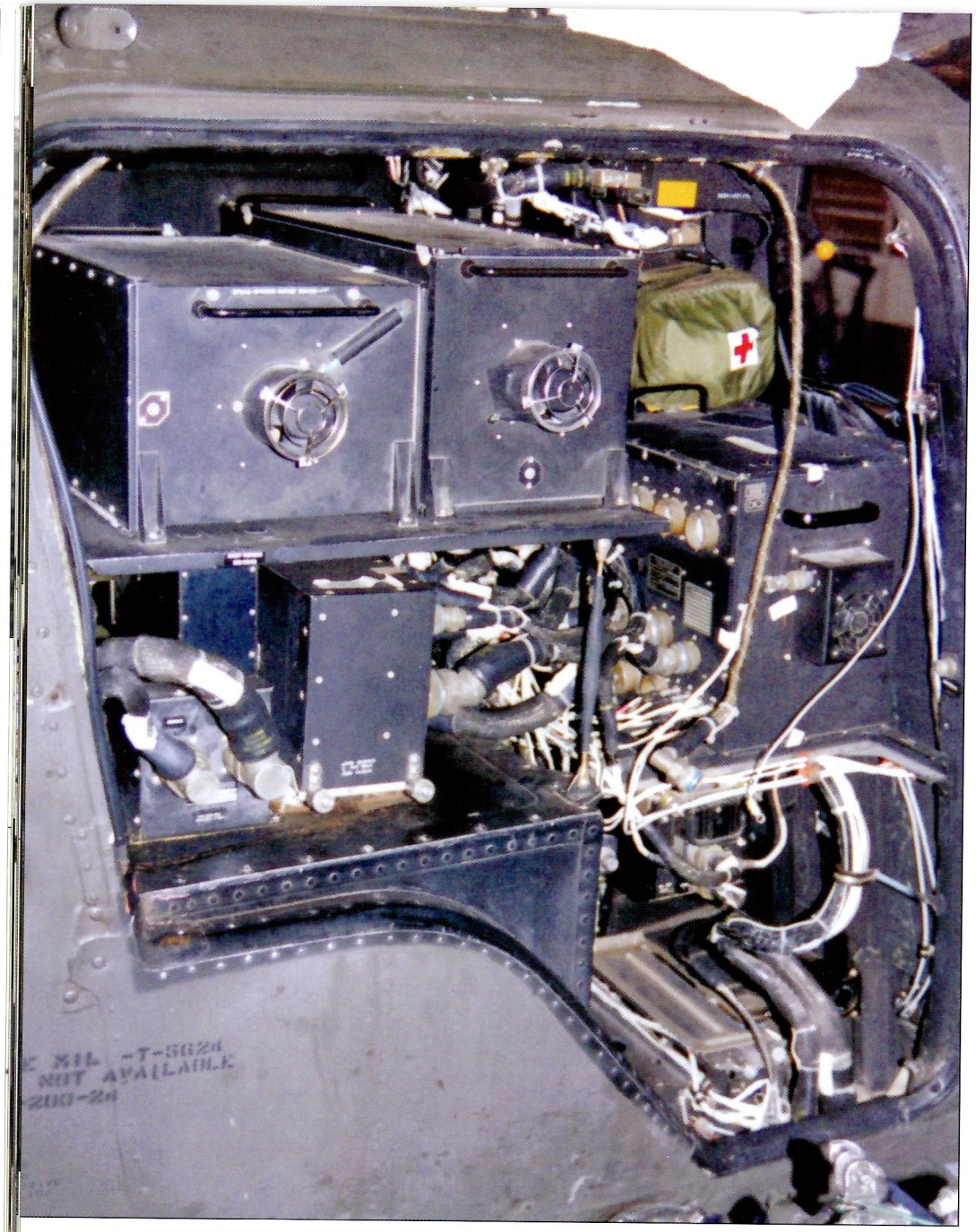
The Kevlar armor side panels protect the crew from small-arms fire. The panel swivels out to the side and rests on the door framing when opened. The panels are kept closed by a small handle on the front of the panel. When the doors are on, pilots will frequently let the panel lean on the door, giving them a little bit more room. The panels are painted flat black inside and out. The handle is typically yellow. The whole assembly is surrounded by a rubber strip to protect the panel.

Sitting on a British ready pad in Bosnia in 1998, this OH-58D(R) of D Troop, 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division, is part of the Stabilization Force (SFOR). The SFOR markings are white with a light overspray of black to tone them down. Desperado Troop was one of the first units to receive the R model of the Kiowa Warrior with new electronic equipment. The skull with a Stetson unit marking is on the right side of the ALQ-144 housing, and the Garryowen crest is on the left side.

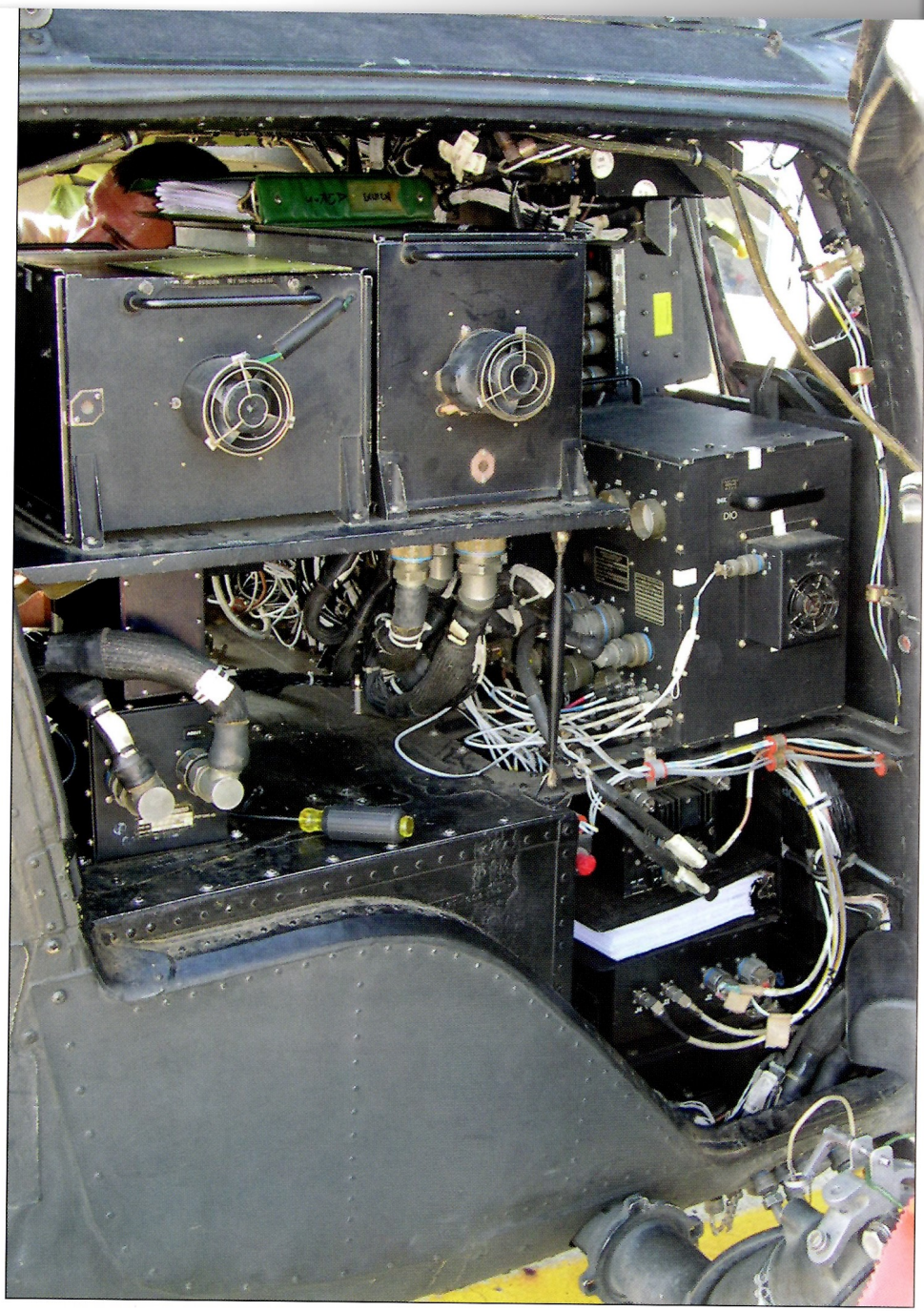
Two doors reveal the evolution of the door panels. The earlier door on the left could only be opened about three inches before the bottom hit the weapons pylon. This meant the door had to be removed every time someone wanted to get into the back to work on the electronics. To solve the problem, a cutout was made in the door, and the remainder was attached to the airframe. That allowed easy access without removing the door. The hole on the modified door is for the AVR-2 antenna.



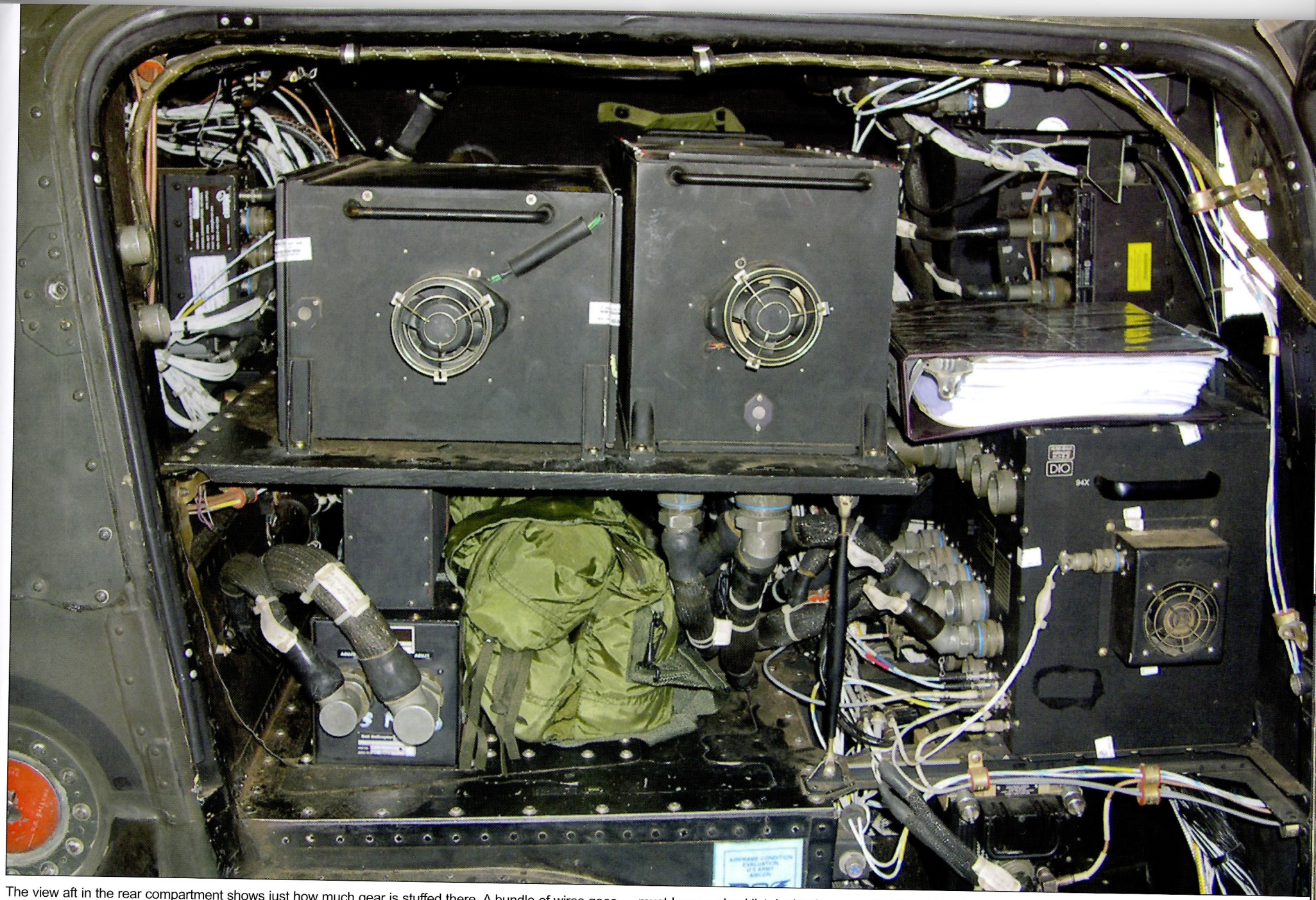
Operating in the scorching sun of Iraq and Afghanistan caused major cooling issues with the MMS electronics behind the seats. Since the Kiowa Warrior is not air-conditioned, the high operating temperature started to cause premature failures. Another vent hole was cut into the top of the door to force a little more air into the back. This additional hole below the original one did the trick. This modification was done around 2002 in country. The back of the AVR-2 antenna can be seen in green on the door.



The Improved MMS System Processor (IMSP), top left, and the MMS Central Power Supply (MCPS) next to it are in the right side back seat. The IDM is on the cabin roof. The first aid kit is mounted on the center broom closet, and the IMCPU is right behind the seat. The Interface Electronic Unit is below the IMSP, and the Mast Torque Signal Conditioner is behind it. The Armament Electrical Unit is against the back bulkhead.



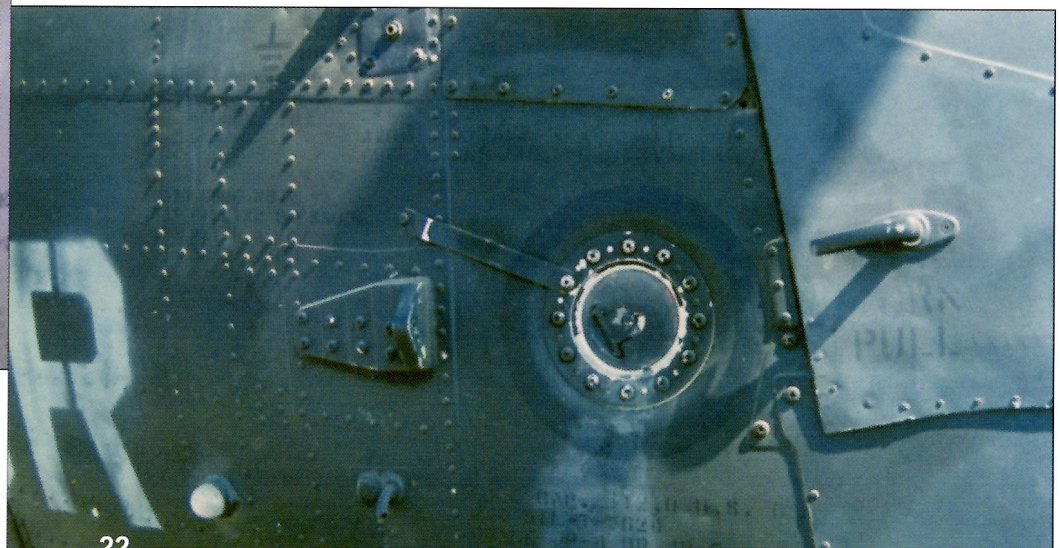
The latest version of the backseat has changed slightly. The additional items on the floor are part of the Blue Force Tracker System, and components of the CABS are in the place of the first aid kit, which was moved to the left rear door. The crew chief is performing maintenance on the aircraft, indicated by the screwdriver and logbook on the MCPS. The IMSP and the MCPS are the primary black boxes for controlling the MMS.



The view aft in the rear compartment shows just how much gear is stuffed there. A bundle of wires goes to the MMS and the power distribution buses in the aft avionics compartment. The IMSP controls the interface with the Cockpit Display System; the Attitude, Heading, and Reference System; the Airborne Target Handover System; and the video recorder. The shelf on the rear part of the cabin contains armament controls for the Hellfire, as well as some aircraft survivability equipment. Every time the helicopter flies, it must have a checklist, logbook and a -10. The -10 is short for TM55-1520-248-10, otherwise known as the operator's manual. Here the -10 is on top of the right IMCPU. A logbook tells the pilot the condition of the helicopter and is normally kept up front for easy access, as is the checklist. The green bag is a combat lifesaver bag, which contains medical equipment and supplies to give an IV and treat more serious wounds than those treatable by the aircraft first aid kit.

"Executioner" is a Warrior assigned to the 3rd Squadron, 7th Cavalry Regiment, 3rd Infantry Division, out of Ft. Stewart, Georgia. The aircraft set down in a forward area rearming and refueling point. Every one of the ground crew members has a specific job. The sequence starts from the inside out. The left side can be armed while the right side is gassed up and then loaded. Crews are supposed to avoid walking in front of armament. The aircraft is refueled and rearmed "hot," which means that the aircraft is not shut down. (*DoD*)

The fuel filler port is on the right side of the aircraft. The fuel cell is a crashworthy, self-sealing, ballistically tolerant (small arms) bladder cell that holds 112 gallons of JP-8 fuel. The tank vent is just aft of the filler port. The grounding point for the refueler is at the top of the photo. A white infrared formation light is in front of the "R." The light is invisible to the naked eye but is bright when viewed through NVGs.



The aircraft survivability equipment includes the AVR-2 laser detector system. It has four sensors, one on each rear door and one on each side of the rear fuselage below the ALQ-144. They are each different so the detector can tell the pilot which direction the laser is coming from on the APR-39 indicator in the cockpit. In low-intensity conflicts, such as Iraq, where the threat of laser-guided munitions is nonexistent, these items are often removed to save weight, and the remaining spaces are covered with panels.

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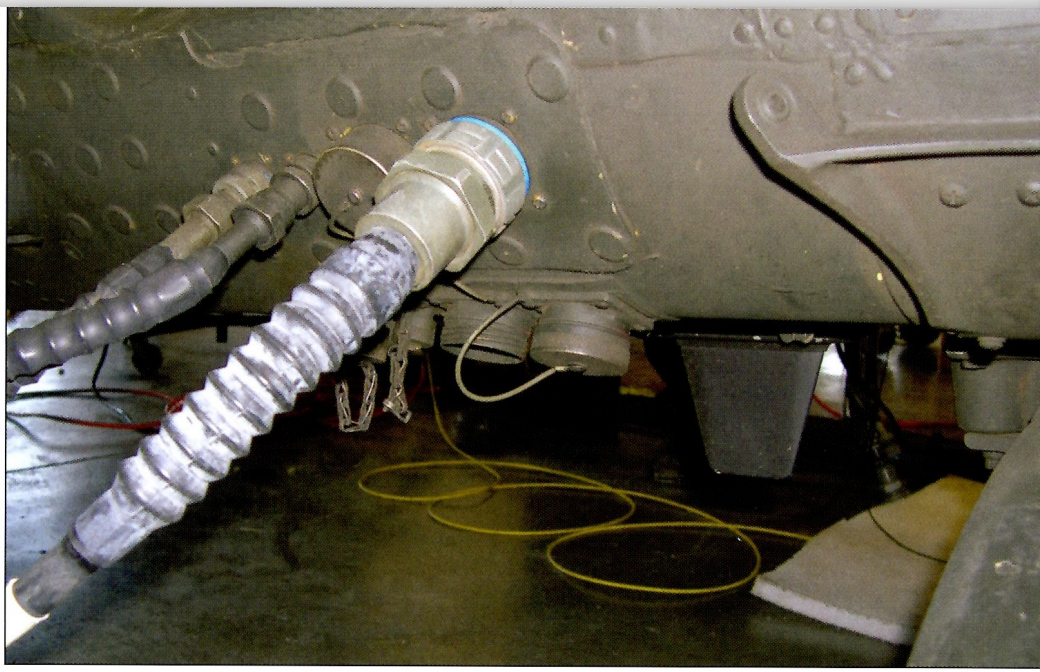
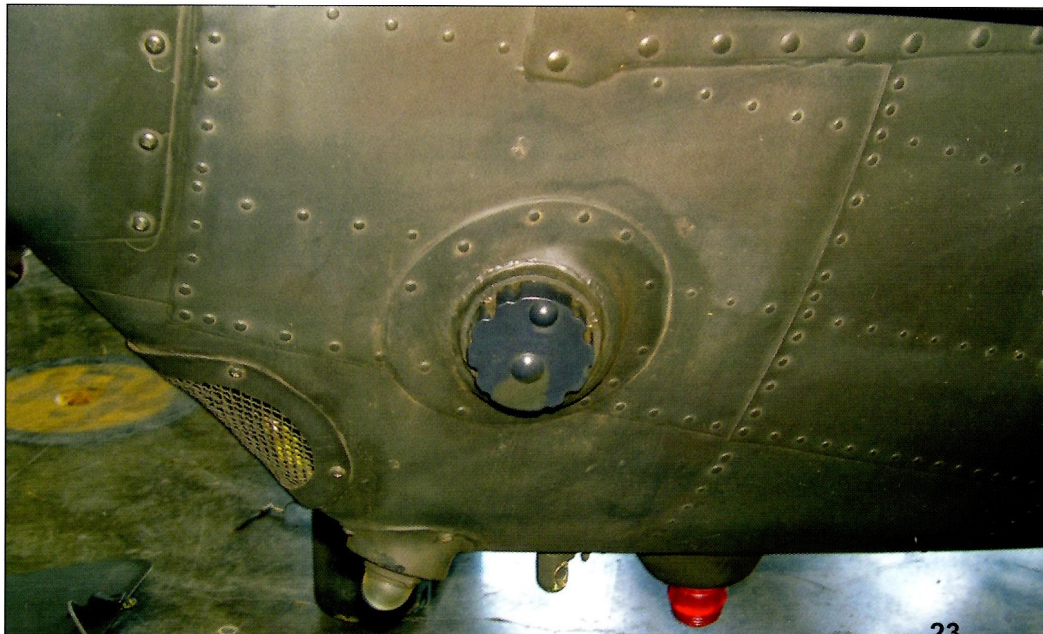
The entire helicopter is painted in a chemical agent-resistant paint, FS 34031, that is coarse and flat. It stains easily and is difficult to keep clean. The red ribbon coming out of the exhaust is for the exhaust cover. It is draped over the side and secured in the oil service door as an indicator to the pilot that it is installed and needs to be removed before flight. The ALQ-144 is mounted on its pedestal below the exhaust and behind the oil cooler exhaust port.



Because the OH-58D is capable of firing multiple armament systems, it has numerous connections on the fuselage. Specific systems determine which cable and plug combination is used. The black antenna under the belly is part of the APR-39 radar warning system and indicates when a radar-guided missile is in the acquisition and track mode. This, in turn, alerts the pilot with aural and visual indicators in the cockpit.

The very aft part of the fuselage houses the lower anti-collision light and the APR-39(V)2 antenna. The clear light on the belly is another infrared formation light. A jacking point is installed between the lights. The screen allows heat from the avionics compartment to escape and keeps the components cool.



Although the Kiowa Warrior is capable of doing rolls and loops, Army regulations limit it to 30 degrees elevation, which this aircraft seems to be just about reaching. The two small square antennas on the back of the fuselage are radar altimeter antennas.

The rectangular panel in front of the rear AVR-2 laser detection antenna and mount is for servicing the tail rotor servo in the fuselage.

Taiwan is the only country other than the United States to purchase the Kiowa Warrior. The Taiwanese and U.S. aircraft are essentially the same; only the servicing data is supplemented. The white number on the forward FM antenna is the Bell Helicopter production number, and the black number under the forward cowling is the army tail number. The two have no correlation to each other. (*Louis Chang*)

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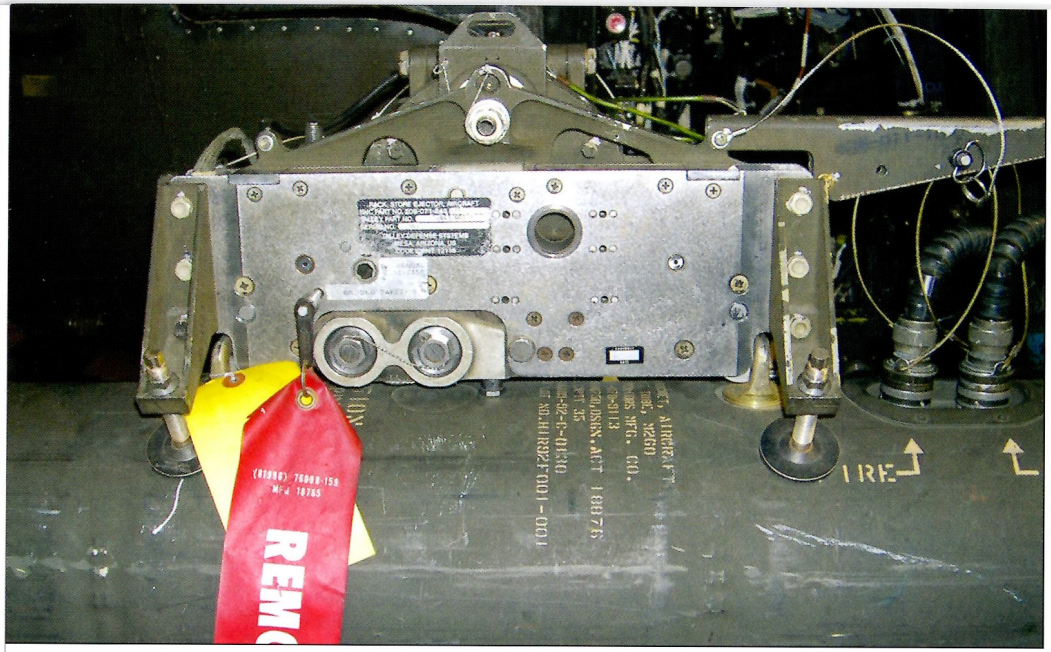
A 17th Cavalry Regiment Warrior patrols in Al Shahabi, Iraq, in 2005. The AVR-2 antennas, the HF antenna under the tail boom, and an FM antenna above the windscreen have been removed. Armed with a rocket pod on the right side and a .50-caliber machine gun on the left, this aircraft is ready to hunt Iraqi insurgents. The aircraft has Multipurpose Light Helicopter (MPLH) landing gear, commonly referred to as squat gear. (*DoD*)

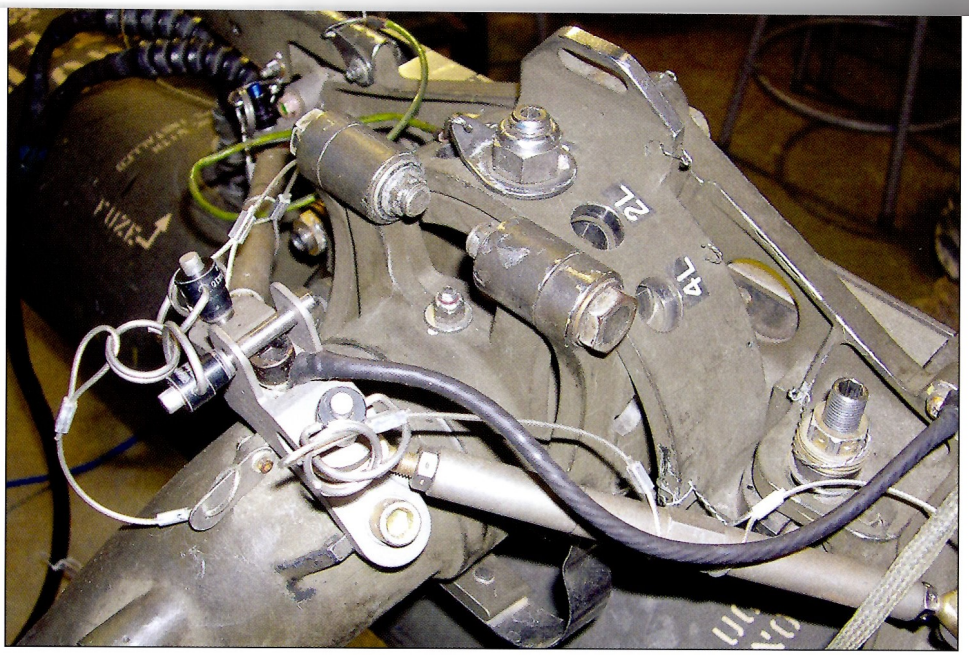
Over Iraq, this Warrior from an unknown unit sports a "Punisher" skull inside a diamond tactical marking. Tail number 24545 is armed with a seven-shot M-260 pod and a .50-caliber machine gun. It also has a complete aircraft survivability suite.

Loaded inside a C-17, this Kiowa Warrior from the 3rd Squadron, 4th Cavalry Regiment, is on its way to Kandahar, Afghanistan. Squatted and on wood shoring, it is chained and strapped down.



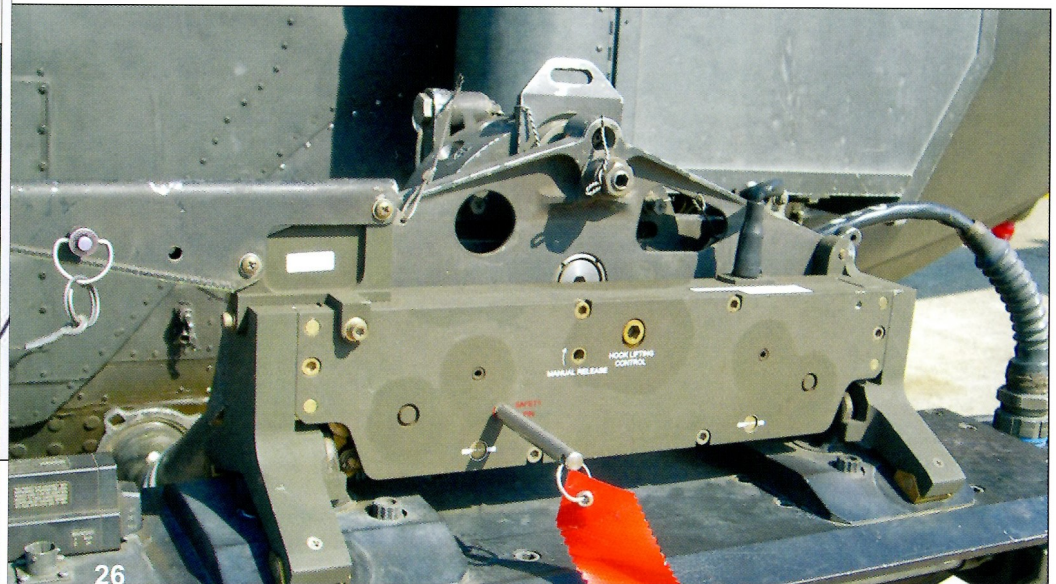
The purpose of the ejector rack on the Universal Weapons Pylon (UWP) is to jettison armament away from the airframe. It provides a single-point suspension on two bomb lugs. The system is activated by the pilot or co-pilot with the armament control panel. Lifting the jettison switch and hitting the jettison button on the collective will cause the impulse cartridges to fire and blow the armament off the helicopter.

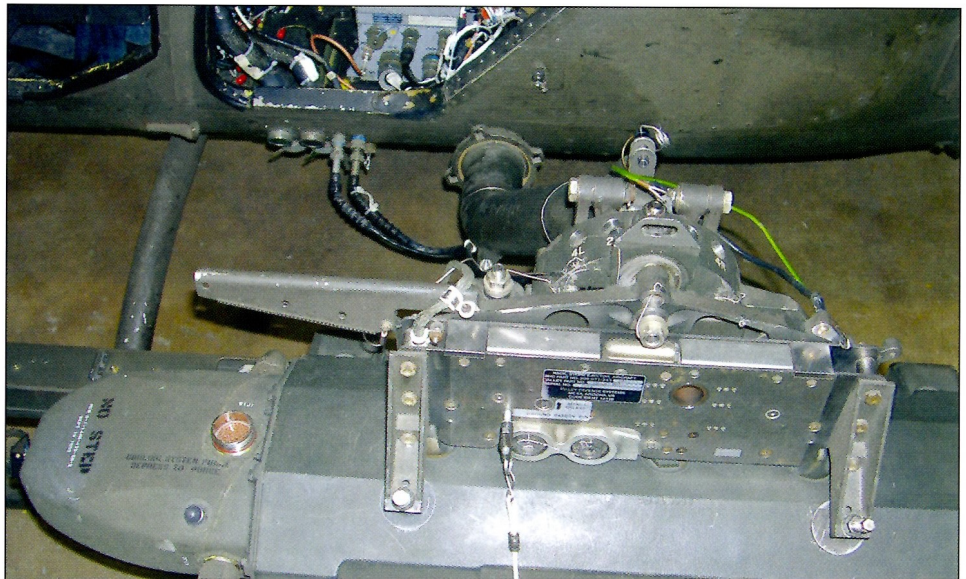
Newer ejector racks weigh less and require fewer inspections than older ones. They are part of the Phase II upgrades for aircraft going to Iraq. Some problems with jettisoning weapons occurred in the desert because of sand getting into the mechanisms. The new upgrade is sealed to keep the sand out and ensure the crew has the ability to get rid of the armament in case of a hung rocket, misfired Hellfire, or fire in the pods.

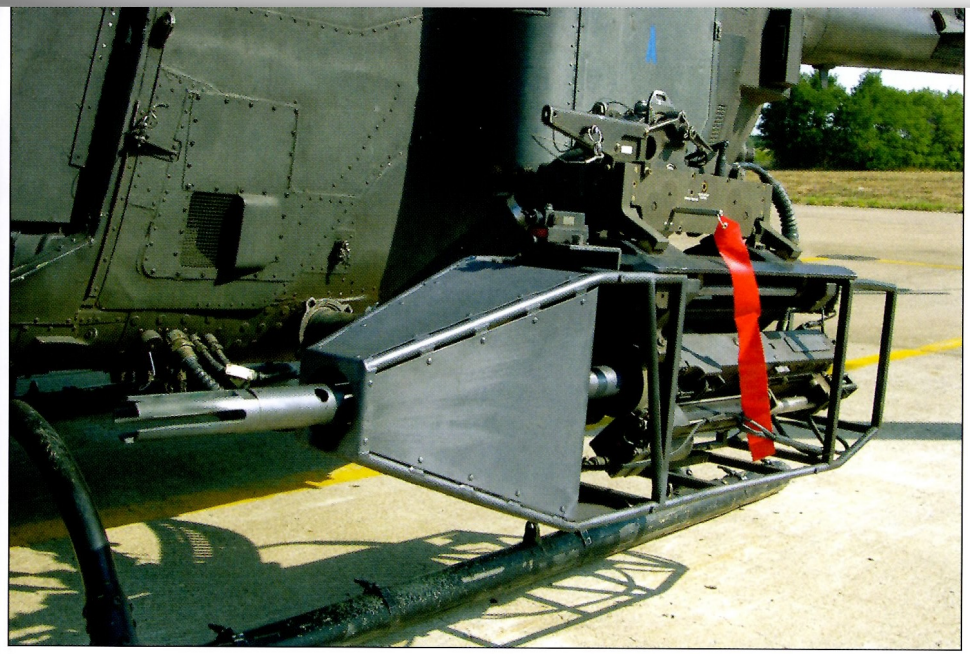


Seen from the top, the UWP contains the boresight adjustment cams (2L, 4L, 0, 2R, and 4R) and houses the hinge fitting to allow the armament to be folded out of the way for squatting. The latest modification to the hinge fitting is two braces that are used for Hellfire missiles. The braces angle back from the hinge at 45 degrees and take some of the stress of firing the missiles off the hinge.

The UWP is angled back approximately 2 degrees from vertical. The UWP's function is to provide attaching points for weapons and routing/clamping points for jettison and armament system cables. The expandable bolt allows the armament system to be folded away. By removing the bolt and the pin that will secure the armament up, the armament can be man-handled up and out of the way. With the hinge fitting pinned and the expandable bolt reinstalled, the aircraft is ready to be handled. In this case, the Hellfire is missing the firing cable on the front of the rack.

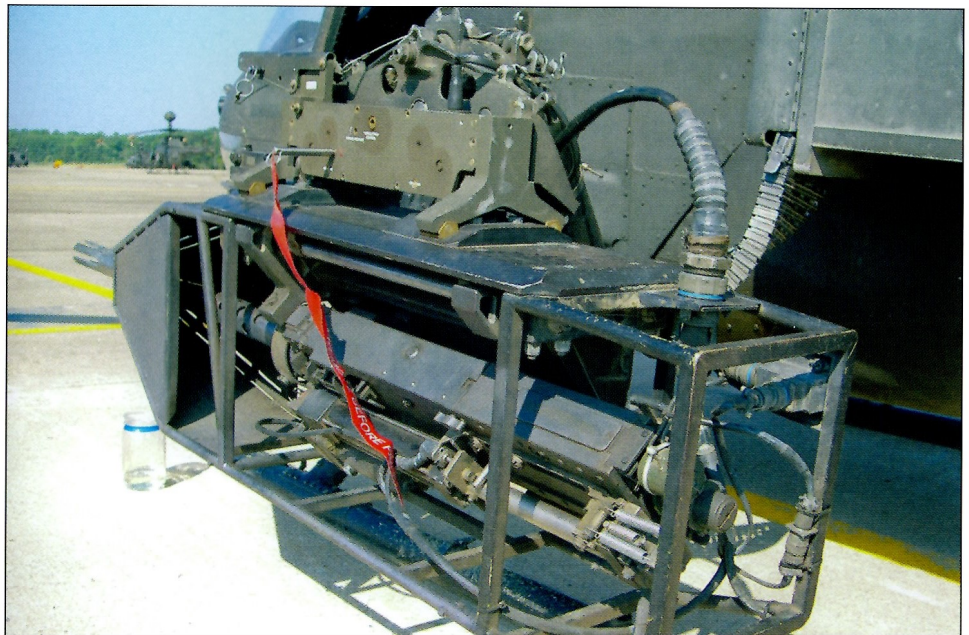






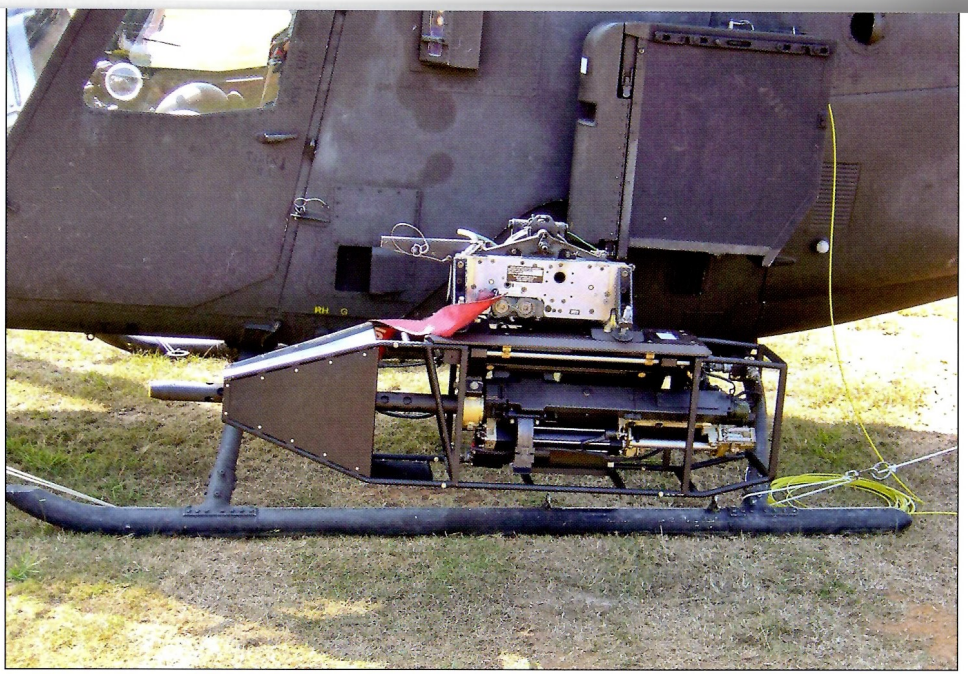
The M2 machine gun has been around since World War II. It is an air-cooled, belt-fed, recoil operated, electronically controlled weapon system. The firing rate is 750-850 rounds per minute, with a maximum effective range of 2,000 meters. The capacity of the ammo supply system is 500 rounds. The spent shell casings are ejected overboard. A flash suppressor and barrel extension have been added to the gun.

The gun assembly consists of a back plate assembly with a solenoid to load and clear the system electronically. The system has a recoil and buffer assembly. Even with these, the .50-caliber's recoil packs quite a wallop. Firing the weapon system with the front doors on will frequently vibrate the co-pilot's door sufficiently to open or loosen it.



Sitting on the tarmac in Iraq, this C Troop, 1st Squadron, 17th Cavalry Regiment, Kiowa Warrior is armed and ready. (*Mark Martin*)

The ammo can holds 500 rounds of .50-caliber ammunition. If necessary, an additional 24 rounds can be loaded into the chute. The ammunition is belt-fed and dragged out of the can by the gun as needed at 750 rounds per minute. The top of the ammo can is designed to be used as a work platform. The can is frequently used to carry personal gear if the gun isn't mounted or being used.



Taiwan's .50-caliber systems does not have a barrel extension. This does not degrade the system performance, but it does create issues of the flash shutting down the NVGs. The single burst limit is 150 rounds before the barrels have to cool down for one minute to prevent cook-offs (premature detonations). The ammo can attaches to the side of the fuselage by quick-disconnect pins and is connected to the gun by a flexible ammo chute. (*Louis Chang*)

The ammo can is often a canvas for unit insignia, such as this of C Troop, 1st Squadron, 17th Cavalry Regiment. (*Mark Martin*)

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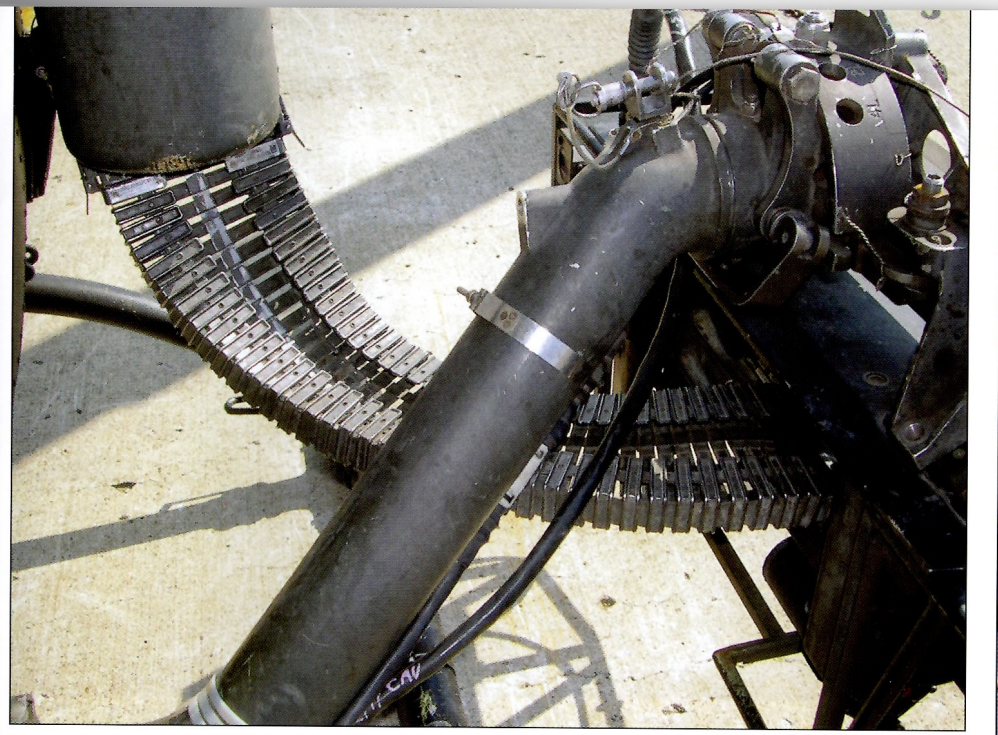
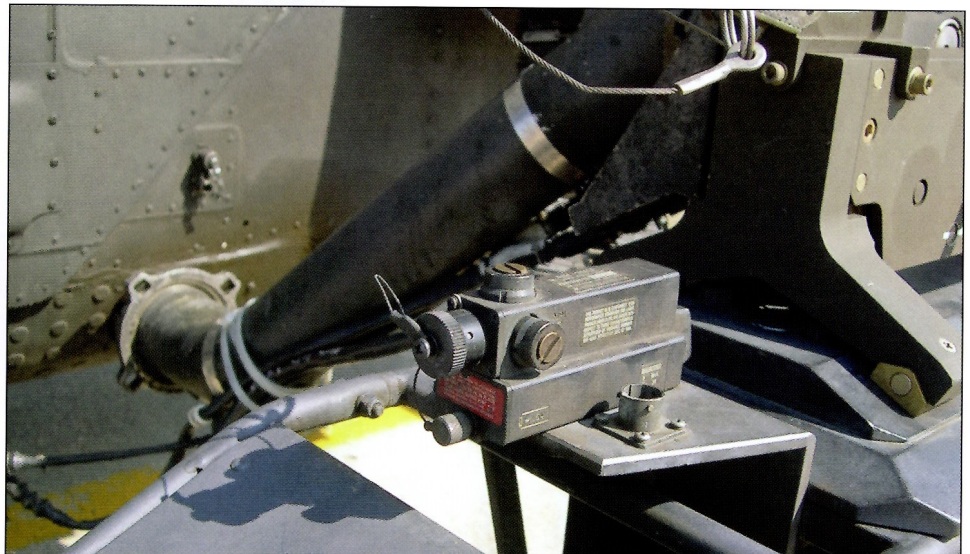
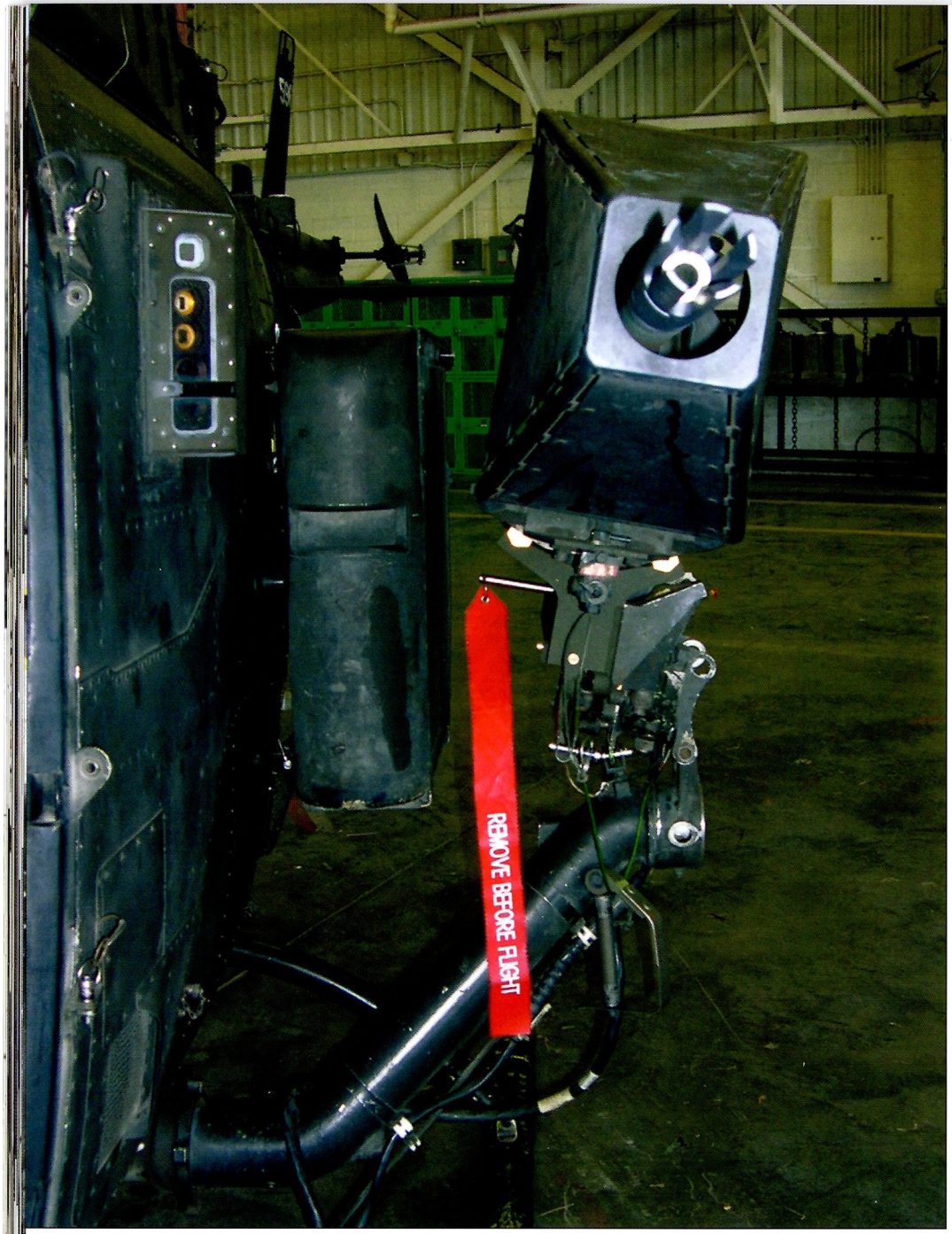


The ammo chute is flexible and feeds the .50-caliber ammunition to the gun receiver assembly. It attaches by bayonet clips to both the storage can and the gun and is easily removed. If the gun isn't going to be used, the chute is frequently removed and kept in the ammo can along with the rest of the flyaway gear, so named because if not stored, it could fly away either from lateral procurement or from rotor wash.

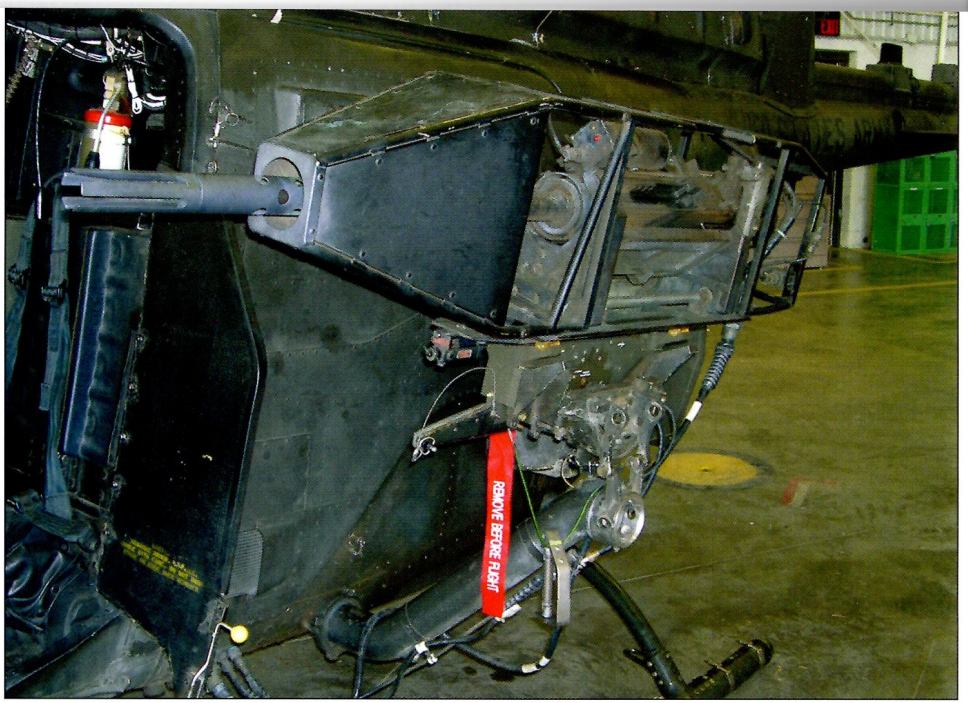
This AIM-1 laser pointer has its cover on and its cable disconnected. The laser pointer is used in conjunction with the NVGs and provides a good indication of where the rounds will hit. It can be left on continuously or used intermittently and controlled by the pilot with a switch on the collective. It is boresighted with the gun and mounted on top of the gun cage.



The AIM-1 cable is connected and ready to fire the system. The "No Step" warning is a local unit warning to remind the crew not to use the gun as a means to get up on the ammo can, which could throw off the boresight. The preferred method to get on top of the helicopter is to step on the UWP at the bend, being careful not to step on the AIM-1 cable, and then on the hinge point to the ammo can lid.

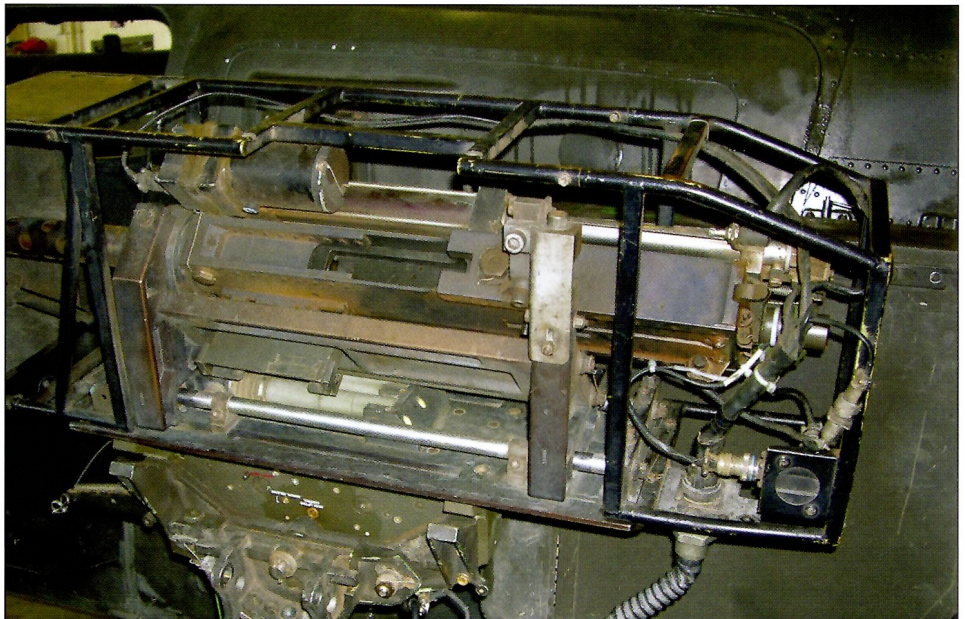


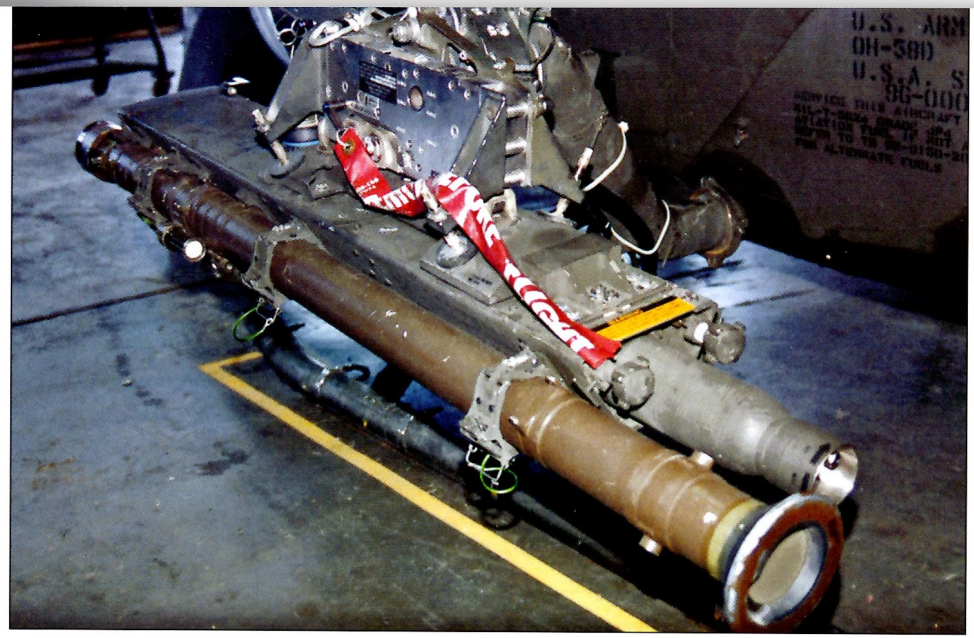
A Warrior's .50-caliber machine gun has been rotated up while its cables remain attached. The armament on the Warrior can be rotated up to aid shipping and ground handling. Hydraulics do not help fold the 171.5-pound empty gun system; it is all done by muscle. The barrel is 36 inches long, and the gun is 56.25 inches long overall. The system weighs 338.5 pounds when fully loaded with 500 rounds.



The Warrior's .50-caliber machine gun sits slightly over center when folded up so it will stay in position until the crew chief inserts the safety pin. The expandable pin is then either put back in its holes or attached to the cables, depending on whether the aircraft is headed to long-term storage or just being ground handled to the ramp.

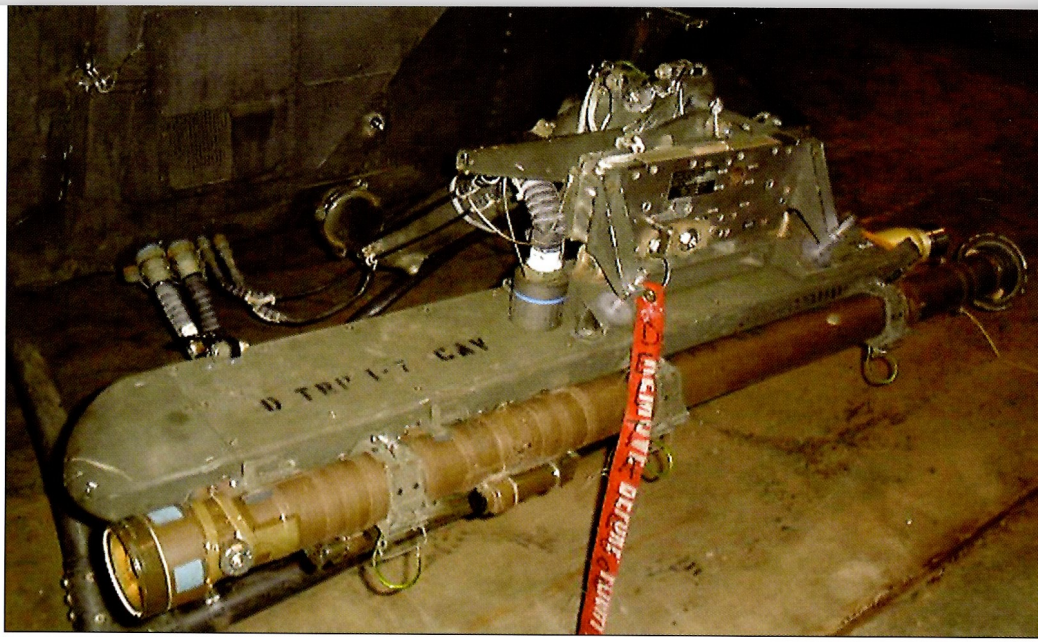
The receiver assembly and the inside of the gun cage, including the wiring, is visible when the ammunition chute is removed. The .50-caliber machine gun is not usually seen in this position.





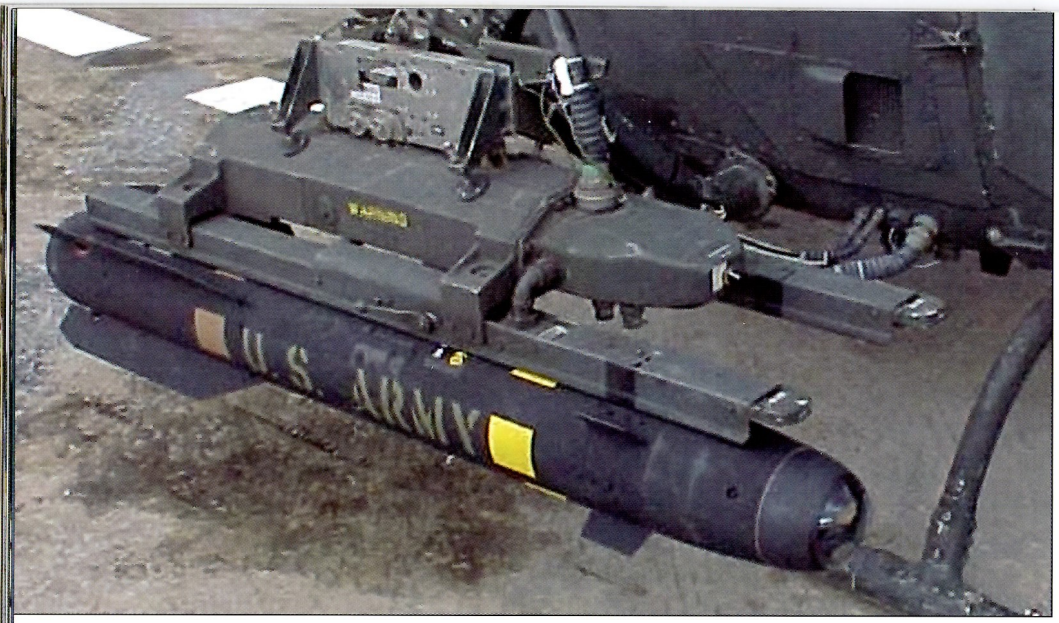
The ATAS system contains two Stinger missiles and one tube of cooling argon gas for each launcher. The Warrior can carry two launchers but normally carries only one. This launcher has one captive flight trainer mounted on the outside and the argon tube in the center. The missile can be aimed and launched without the pilot removing his or her hands from the controls.

The ATAS is a supersonic “fire and forget” missile. The pilot can use the PDU or the MFD to aim and fire the missile. The PDU is often not mounted since it is directly in front of the pilot and cuts down on visibility. The missile is 59 inches long and 2.75 inches in diameter. Each missile weighs 22.4 pounds. The missile consists of a guidance section, warhead, flight motor, and launch motor.



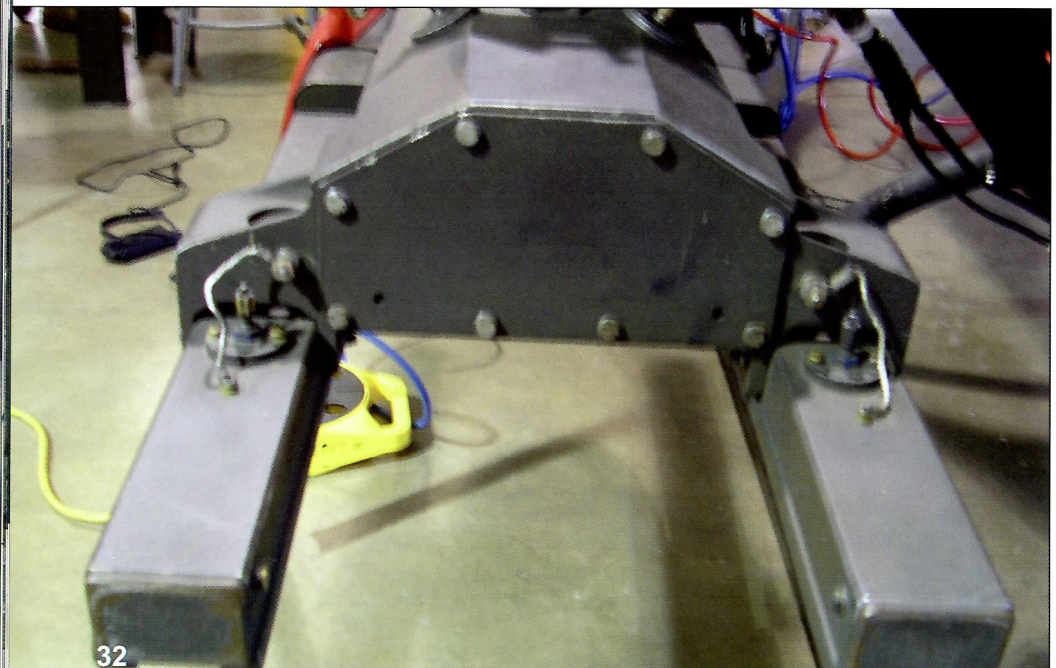
The Stinger missile is held onto the launcher by three latch assemblies. Only one missile can be fired at a time. The launcher provides a platform for two missiles and is elevated 4 degrees above the armament datum line to compensate for missile drop. The launcher houses an electronic assembly that provides the power for firing the missiles.

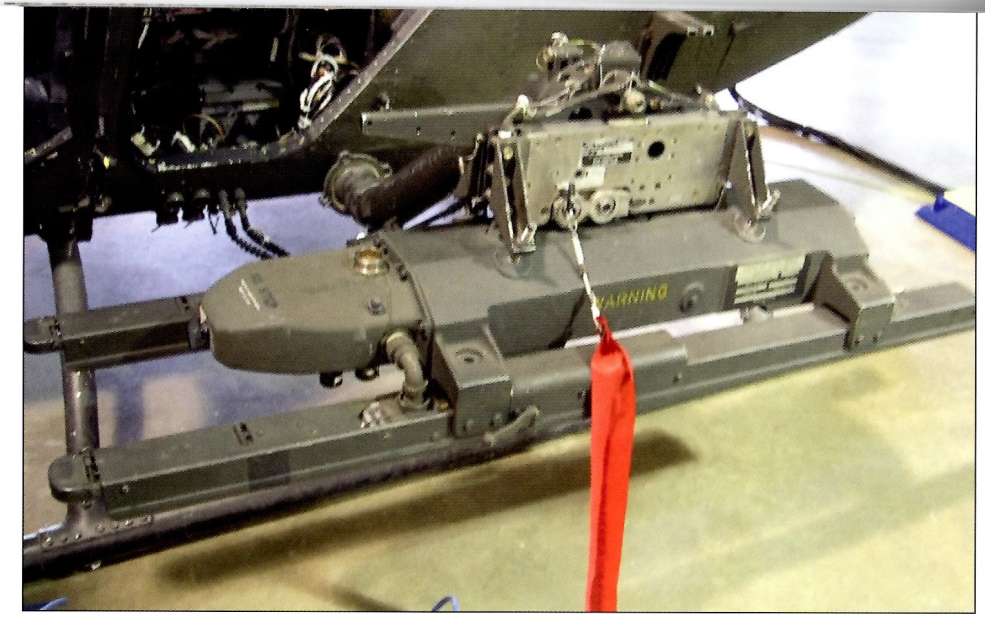
An ATAS is shot from a Warrior at Yuma Proving Ground in Arizona. The long plume of smoke is a trait of the Stinger missile. It reaches supersonic speed within 1.5 seconds of firing.



The Hellfire system is mounted on an M272 launcher and is configured to carry two Hellfire missiles per launcher. Three missile configurations can be set: dummy, training, and tactical. A dummy missile is externally the same as a tactical missile, but internally carries only ballast. A training missile has a captive flight training warhead without a motor or explosives. Tactical missiles can be identified by yellow markings indicating live warheads and brown markings indicating live motors.

The back of the launcher houses the electronic assembly. It is powered by 115 volts of AC power.



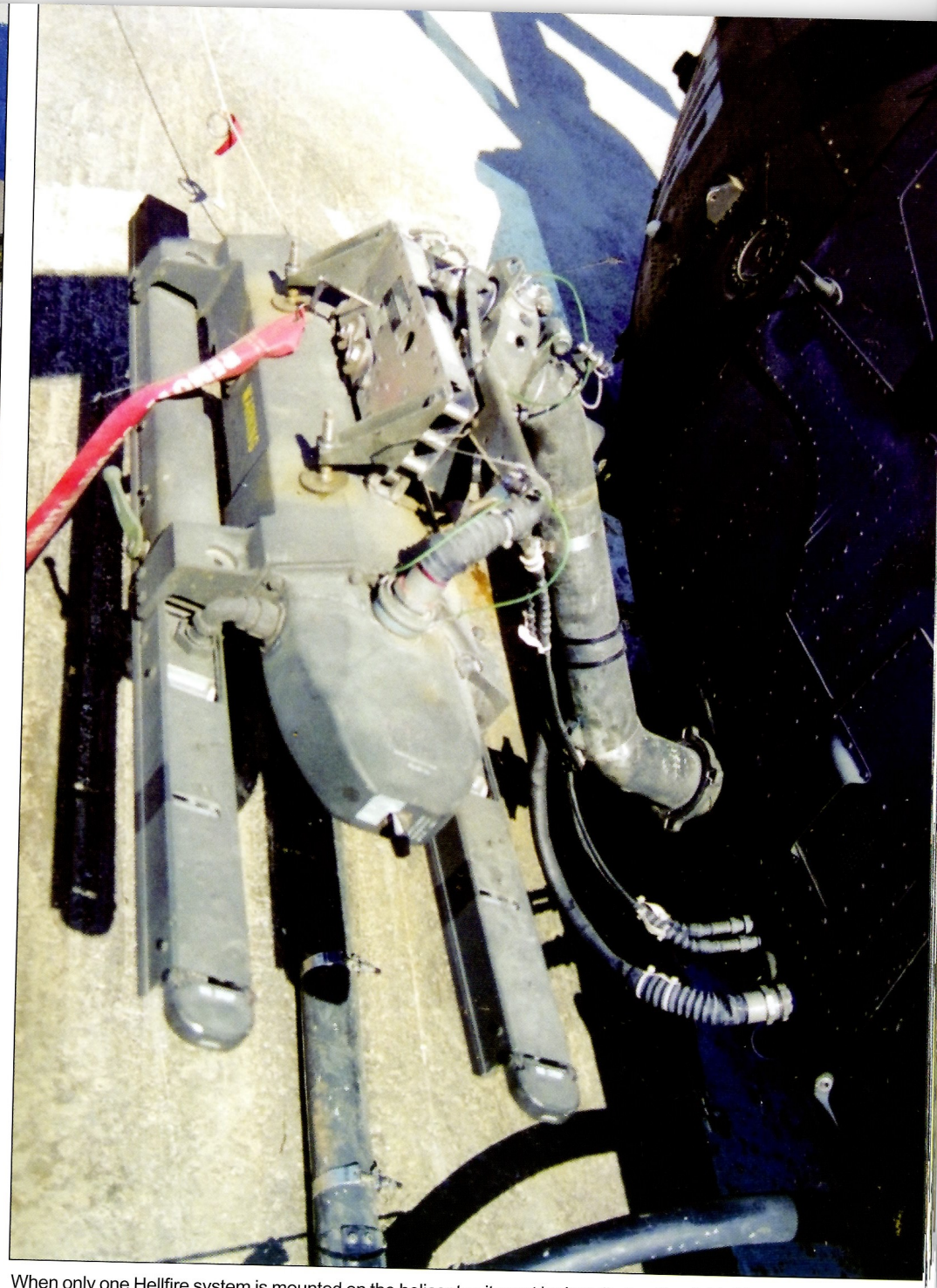


The Hellfire system can be mounted on both UWPs; however, if it is mounted with any other armament system, the Hellfire must be loaded on the right side. The Hellfire is set to recognize only one laser code. It can be fired and tracked from the launch aircraft or fired by the launch ship and tracked by a ground station or another Warrior or Apache. A “Remove Before Flight” safety pin is installed to prevent injury in case of inadvertent toggling of the jettison switch.

A training missile is indicated by two gold bands. It provides prelaunch data in the cockpit like a tactical missile except it will not fire. A Hellfire consists of seeker, warhead, propulsion, and control sections and weighs close to 100 pounds. The missile itself is 64 inches long with a wingspan of 12.8 inches.

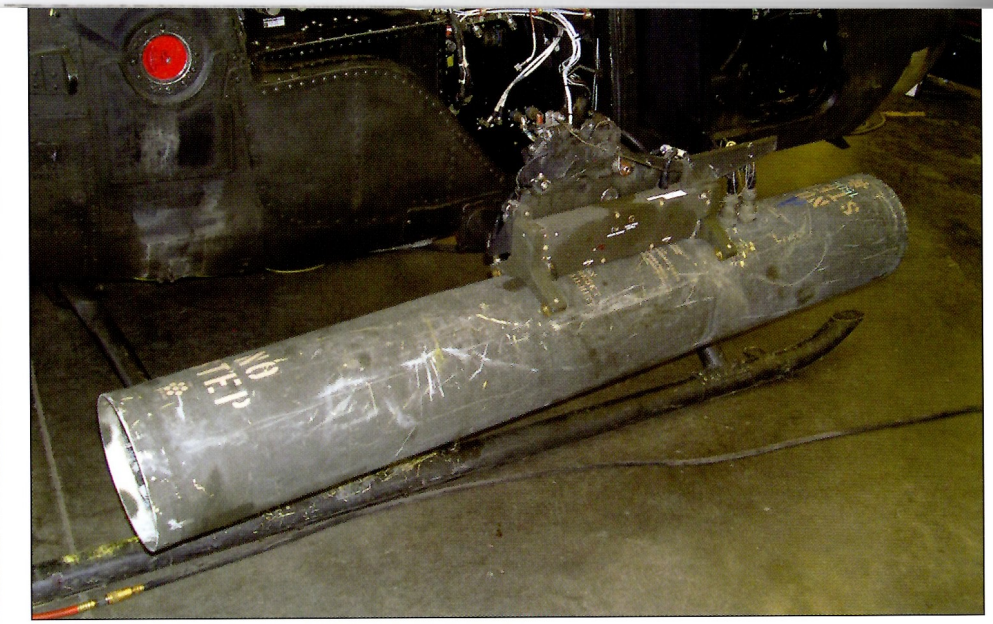
The bottom of the Hellfire launcher provides mounting and holdback provisions for the missile. The rail also contains an umbilical connector and a deice wiring harness. When the missile thrust exceeds approximately 600 pounds, the missile overcomes the holdback handle assembly and is launched.

A Warrior meets up with a convoy to finalize preparations for movement in Iraq in 2006. Packing a single Hellfire on the right side and a .50-caliber system on the left, this aircraft is capable of long- and short-range engagements. The MMS is in standby mode.



When only one Hellfire system is mounted on the helicopter, it must be installed on the right side. A second can be installed on the left side in a heavy Hellfire configuration.

Armament Dawgs (a term of respect) load 10-pound point-detonating rockets into a pod. The rocket consists of a motor, warhead, and fuse assembly. Training rocket warheads are painted light blue, and live warheads are painted green. The brown band on the rocket indicates a live motor. Each rocket has the explosive power of a 155 mm artillery round.



The M260 seven-shot, 2.75-inch rocket pod is 65.25 inches long and 9.76 inches in diameter. Each pod weighs 35 pounds empty. The helicopter and the rocket pod were originally painted the same color, but the pods show signs of wear and tear from frequent handling and the high heat of firing. The paint on this rocket pod is noticeably more worn than the paint on the helicopter.

The 2.75-inch Folding Fin Aerial Rocket (FFAR) comes with a variety of warheads. The rockets can carry 10 or 17 pounds of high-explosive, white phosphorus, multipurpose submunition, illumination, or flechette warheads. The rockets are propelled by either the Mk 40 or Mk 66 rocket motors. The Mk 40 has four folding fins, and the Mk 66 has three wraparound fins. The Mk 66 is a faster motor and is the norm for modern helicopter aerial gunnery. On this pod, the expandable bolt is hanging on the power cables.

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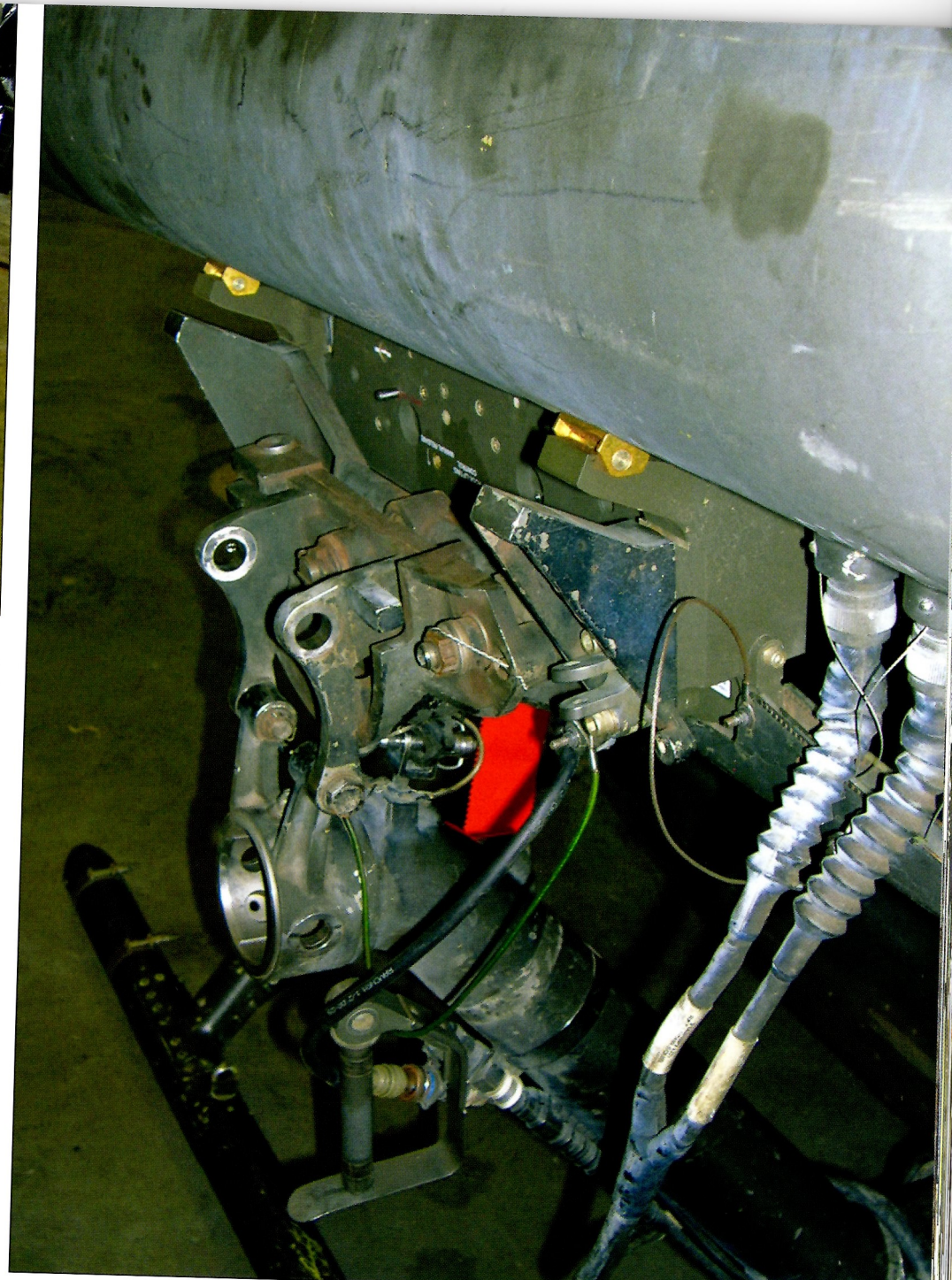
Igniter arms are used to connect rockets to the system. Two sets of contacts "lock" the rockets into place. To load a pod, the igniter arms are pulled back until they lock, and the rockets are loaded from inboard to outboard. The rockets are gently slid back into the tube with a special rubber tool and seated. The igniter arms are then placed in contact with the rocket. This pod is elevated in the shipping and ground handling position.

An expandable bolt hangs from this pod's grounding strap. The Kiowa Warrior is capable of carrying two seven-shot pods, but the normal setup is one rocket pod on the right side and a .50-caliber gun system on the left. A seam runs along the bottom of the rocket pods.



Details of the UWP mount are revealed when it is raised. The mount is the same regardless of which armament system is carried.

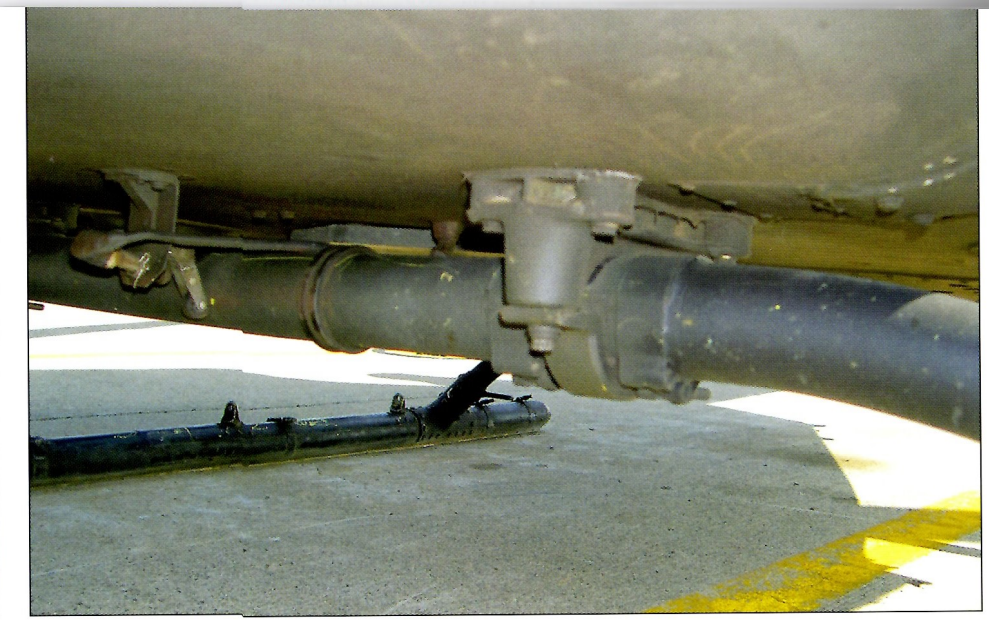
This Warrior from D Troop, 4th Squadron, 7th Cavalry Regiment, 2nd Infantry Division, has two seven-shot M260 rocket pods. The blue rocket warhead identifies this as the Korea Training Center Multipurpose Range Complex gunnery range.

In 2005, tests were conducted with a GAU-19/A (XM-322) minigun system. An aircraft was fitted with the system and tested at Ft. Eustis, Virginia. While the tests had favorable results and demonstrated some weight savings, the system was not put into production because it would have put an additional AC-powered system on the Warrior. (*William Roberts*)

The Multiple Integrated Laser Engagement System/Air Ground Engagement System (MILES/AGES) allows weapons systems to simulate combat. Using lasers, the unit can determine how to employ tactics in a real force-on-force scenario. This Warrior at the National Training Center at Ft. Irwin, California, has a MILES pod on the right side. A kill indictor in the cockpit shows the crew its status. The crews train in normal engagement techniques and learn how to maneuver as part of a large force.

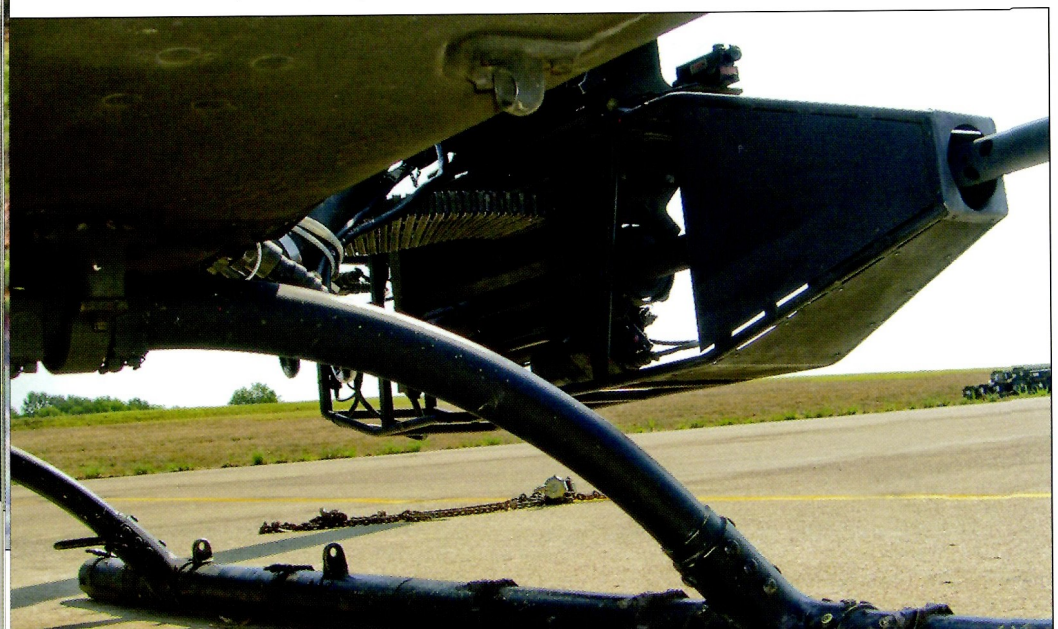
A C Troop, 2nd Squadron, 17th Cavalry Regiment, Kiowa Warrior sits in Iraq in 2006. Armed with a .50-caliber gun system and a 2.75-inch rocket pod, this aircraft represents the configuration for aircraft flying in Iraq in 2006. The doors are on for two reasons: to minimize the amount of sand and dust in the craft and for comfort in the early part of the year when the desert gets cold.

When first conceived, the Kiowa Warrior took advantage of the landing gear of the OH-58A/C. This Kiowa Warrior from an unknown unit displays this early type of landing gear results in a slightly tail-low sit on level ground.



The landing gear is connected to the airframe by four attachment points called strap assemblies. The roller on the front of the forward gear is a weight-on-gear switch, which disables the armament from firing on the ground. The crew can override this feature. In the background are the lifting points for the landing gear and the straps for the replaceable skid shoes

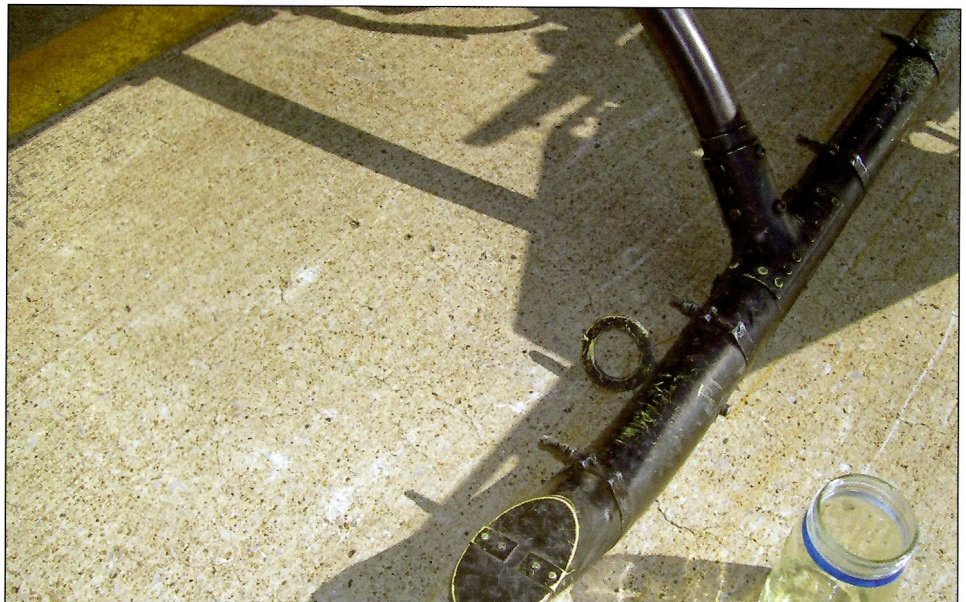
The landing gear consists of two skid tubes with replaceable skid shoes. The skids have two tow rings mounted near the front of the skids and four lifting points for the ground handling wheels. The skids are connected by two curved crosstubes. A pivot support beam is attached to the rear crosstube. The skid tubes are 6 feet, 5.4 inches apart.



Crosstube attachment points use "highloc" rivets on the skids and screws on the crosstubes. The rubber tires of the ground handling wheels have left their marks on the attachment point. One of the lifting lugs is in front of the crosstube. The aft tie-down is the "U" shaped piece of metal on the crosstube attachment point. It is also used with a support assembly bar when ground handling the aircraft over rough terrain or when the gross weight exceeds 4,500 pounds.

Although these ground handling wheels are painted black, they are frequently painted yellow, the usual color of ground handling equipment. The normally used curved handle is sometimes replaced with a straight one. The ground handling wheels can be fitted with the handle to the front or the back, but both need to be on the same way.

The front of the left skid tube shows its ground handling tow ring. The tow rings rotate to allow the tow bar to attach and move the helicopter by aircraft tug or tractor. Just outside the skid is the fuel sample jar for the pilot to inspect for contamination. Four of the eight straps for the replaceable skid shoes are visible in the photo. The shoes comes in two types — one for normal handling and another for training. The training shoes are thicker and normally only used at Ft. Rucker for autorotation and run-on landings.



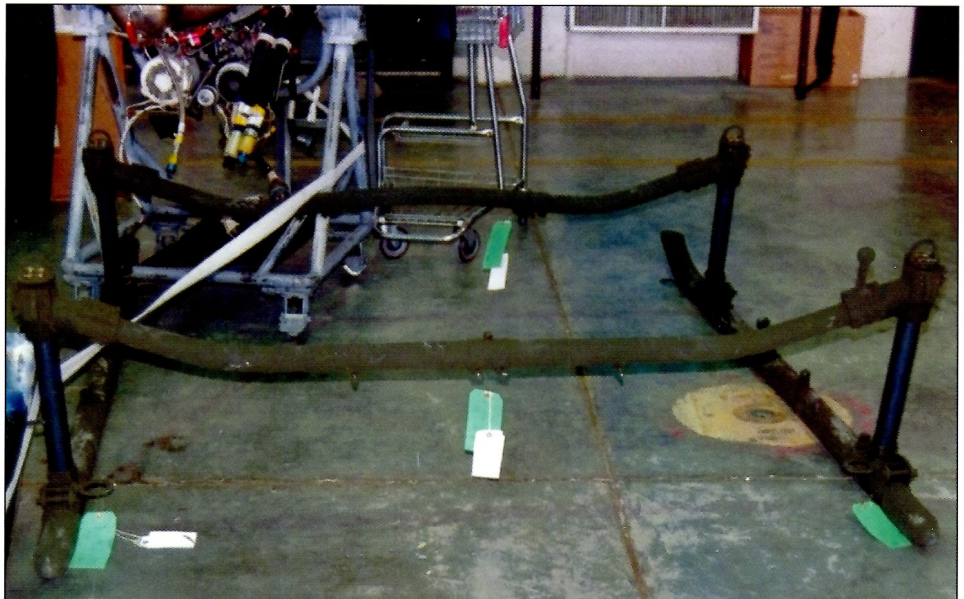
This Kiowa Warrior is on a test flight in September 2006 over Tal Afar, Iraq. The pilot is wearing ballistic face armor, which gives him the appearance of Darth Vader. The face plate armor cuts down on the dust the pilot breathes and keeps the "VOX" from activating when the pilot faces outside the door searching for insurgents. (*Patrick Riordan*)

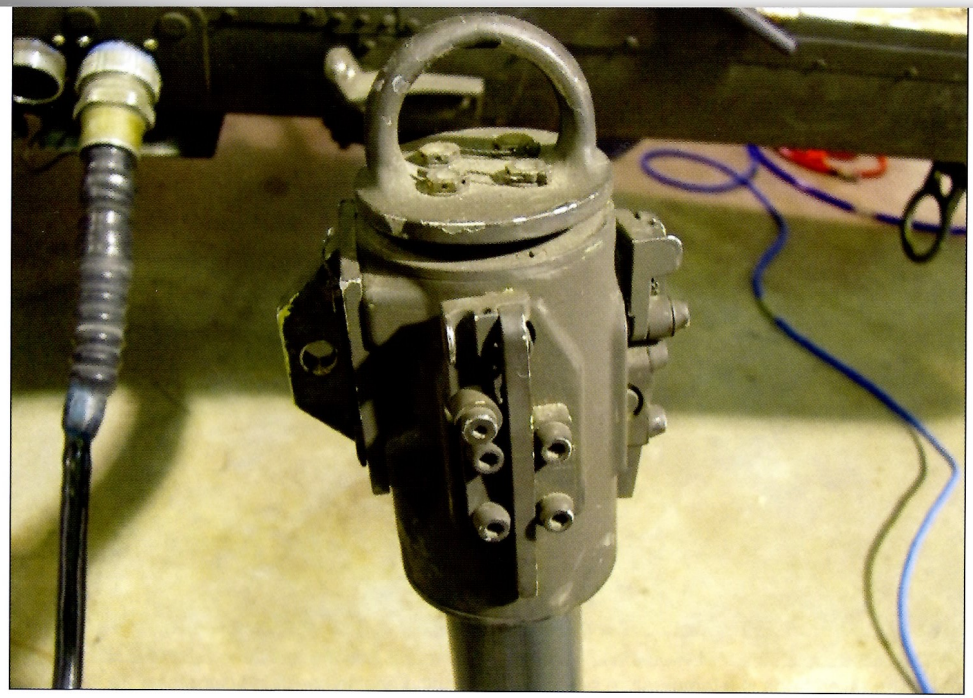
The helicopter ground handling wheels are the same as those used on UH-1s and AH-1s. The wheels are attached to the lugs, and the hydraulics are pumped up by the crew. It takes three people minimum to ground handle the aircraft, one person on each wheel and one on the tail to assist by keeping the helicopter level. A tow bar can be hooked up, or the crew can push the helicopter on improved surfaces.

The forward right front landing gear leg shows the design of the deployment gear. A ball mount on the right skid is a shipping mount for securing the MMS during deployment. The tow ring is just like the conventional gear in that it rotates to accommodate the tow bar.

The MPLH gear allows the Kiowa Warrior to be squatted and deployed by C-130 aircraft. The MPLH gear weighs 114 pounds, compared to 53 pounds for the conventional gear, but the added flexibility offsets the extra weight. This aircraft (95-00081) was the first OH-58D(R) in the Army, assigned to D Troop, 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division, and has the MPLH gear. Its armament is folded up to allow for ground handling.

The design of the deployment gear, as the MPLH gear is frequently called, becomes evident when it is removed from the aircraft. This view is from the rear looking forward.





Locking pins are on the front and outside of the right front deployment landing gear leg. The other corners are the same. The holes and the bottom mount allow the gear to be "rolled" down. It requires four people to squat an aircraft. A good team can reassemble the aircraft in less than 10 minutes.

The bottom of the right front gear leg shows the skid tube attachment point, which differs significantly from the conventional gear. The same tow ring is in place, and, although somewhat stiffer, it still rotates. The skid attachment points are the same on all four points, except the aft mounts have two bars across the mount, instead of the one seen here.

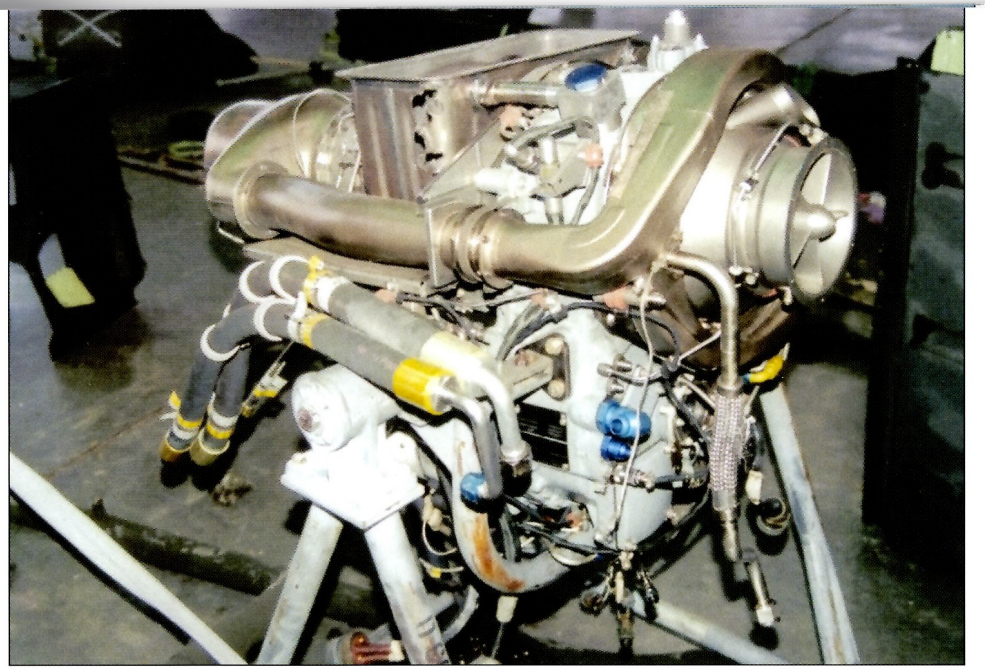
The deployment gear splays out when weight is added to it. This results in a slight splay outward when on the ground and a more vertical appearance when flying.

In a proper squat, the landing gear is squatted, the main rotor blades are folded to the rear, the horizontal tails are folded up, the vertical tail is rotated, and the MMS is removed and placed alongside the aircraft on a special mount complete with jib hoist. Red flyaway gear is foam-filled and stuffed into the inlets to prevent foreign object damage (FOD). (*William Roberts*)

The two lifting lugs on the forward right skid tube are the same as those on the conventional gear; but, unlike the conventional gear, the ball for the MMS removal tool is on the skid. All the skid tube attachment points have a tie-down ring, which in the front also serves as the tow ring. An additional ball mount is on the right rear crosstube for mounting the MMS crane.

The aft crosstube on the MPLH gear has center section mounts that are the same as on the conventional gear. The silver probe is a temperature sensor for performing engine health indicator tests. To the right is a battery vent tube with a screen added to keep insects out.

Squatting allows two complete Warriors to be shoehorned into a C-130. Shoring under the skids protects the transport. The helicopter is secured with 10,000-pound tie-down chains. The MMS support stand holds the MMS, which has a protective cover. The MMS is secured to the stand next to the jib hoist. The same configuration is used on C-5 and C-17 aircraft. The amount of tear-down needed depends on the type of transporting aircraft.

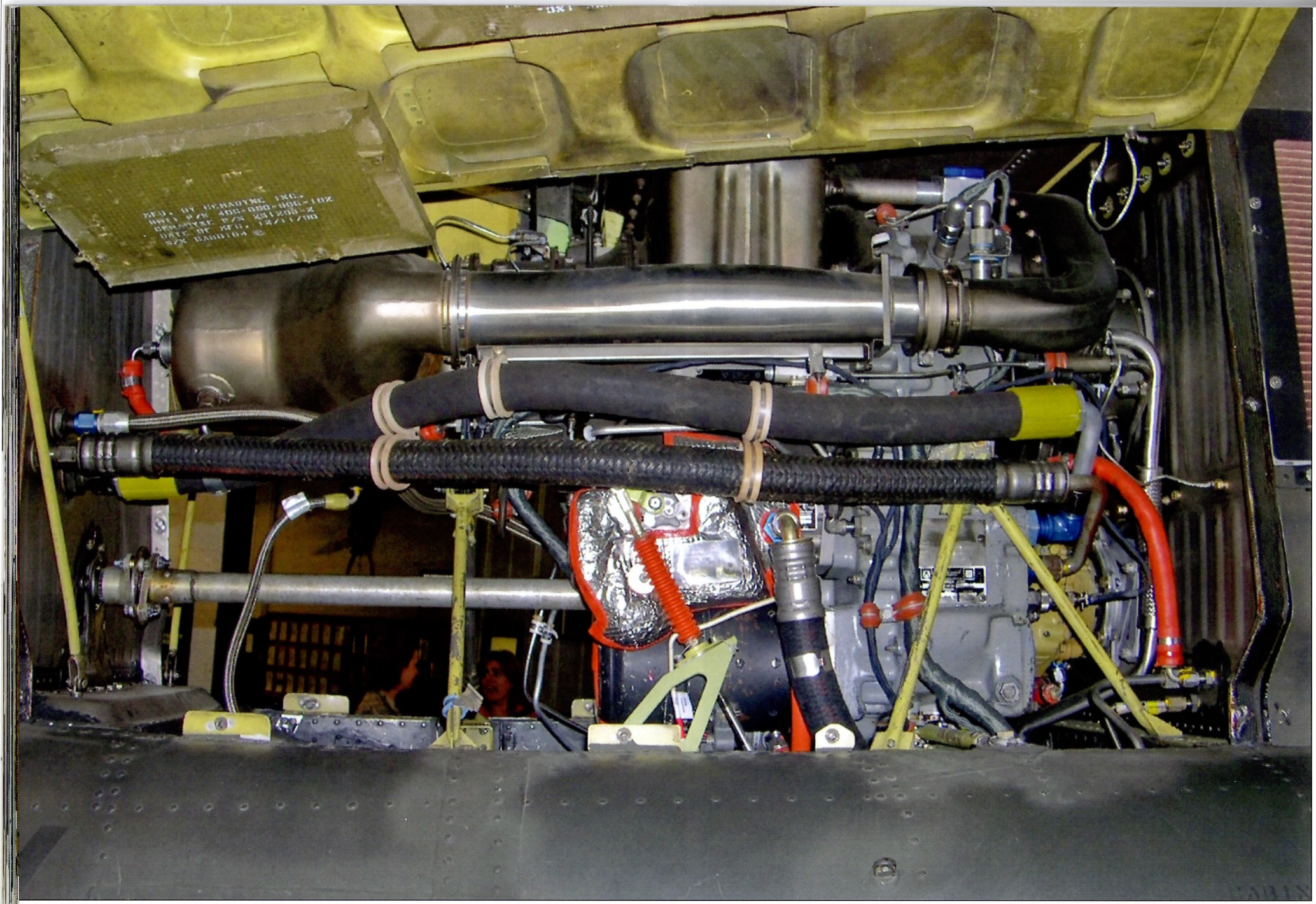


The Rolls-Royce Allison C250-C30R/3 engine powers the latest version of the Kiowa Warrior. Equipped with a Full Authority Digital Engine Control, the engine produces 650 shaft horsepower. The engine has four different sections, or modules — compressor, combustion, turbine, and accessory gearbox. This engine has damage to the exhaust section.

Large doors on each side of the helicopter provide access to the engine and are kept closed with turn fasteners, sometimes called Dzus fasteners. A support rod keeps the doors open. Dark green Kevlar plates protect the engine's compressor and combustion sections. These plates are removable and are often removed in the United States during training. They are always fitted for combat. The swirl tubes are in the upper part of the photo.

The Rolls-Royce Allison engine operates in some austere environments, everything from the snow of Alaska to the desert of Iraq. This D Troop, 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division, Warrior is undergoing engine maintenance in Iraq.

A Kiowa Warrior sits on the ramp in Kosovo. Worldwide deployment at a moment's notice makes the Kiowa Warrior an ideal weapons platform for the U.S. Army.



The foil-covered section of the engine is part of the fuel control system. The fuel control is a hydromechanical unit that controls the fuel flow to the engine. The black tubes running fore and aft are oil supply and return lines. Air discharge tubes, which take air from the compressor back to the combustion chamber, are above the oil lines. The tail rotor driveshaft goes through the rear firewall bulkhead. A new type of air filter has replaced the swirl tubes on the forward cowling.

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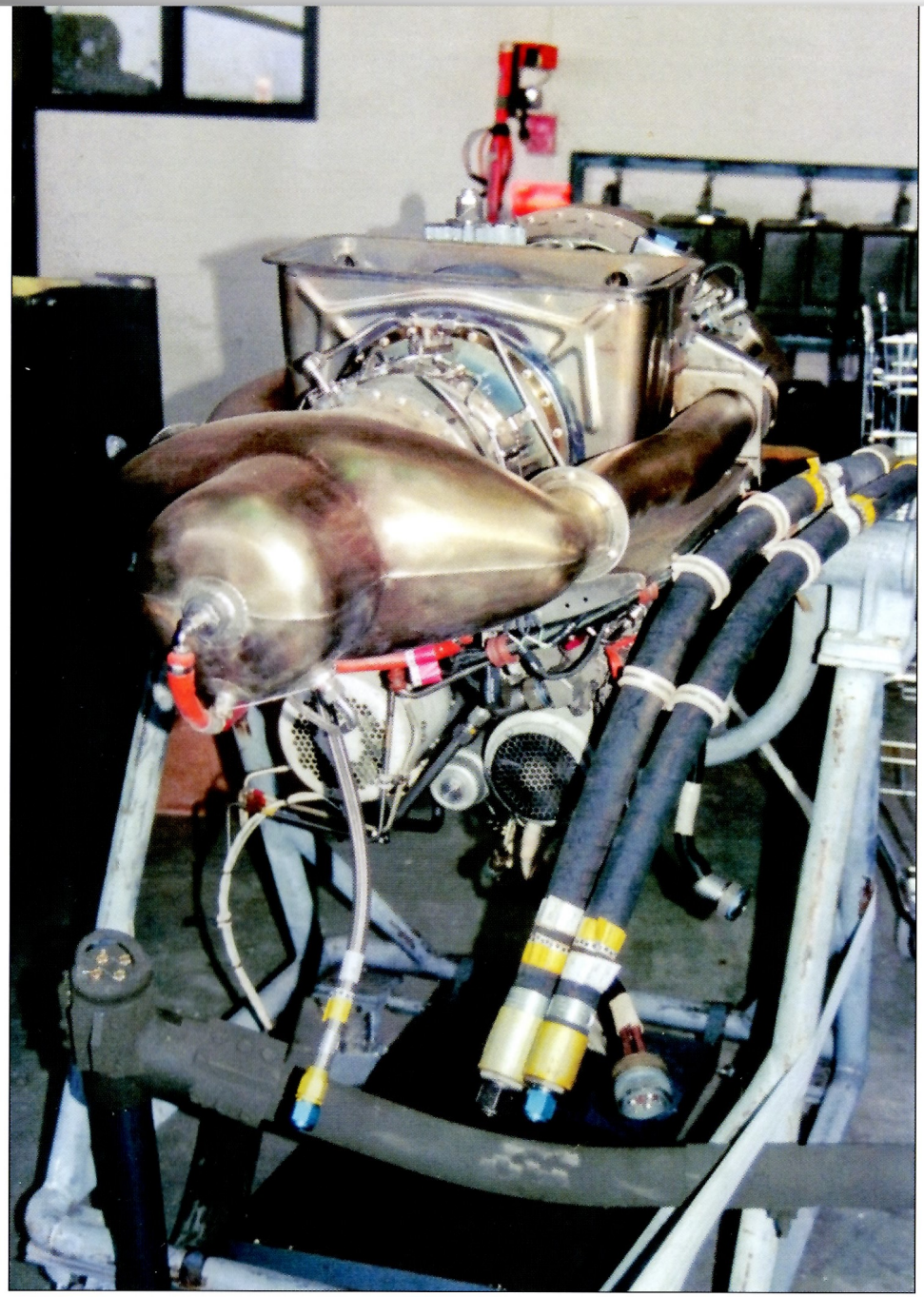
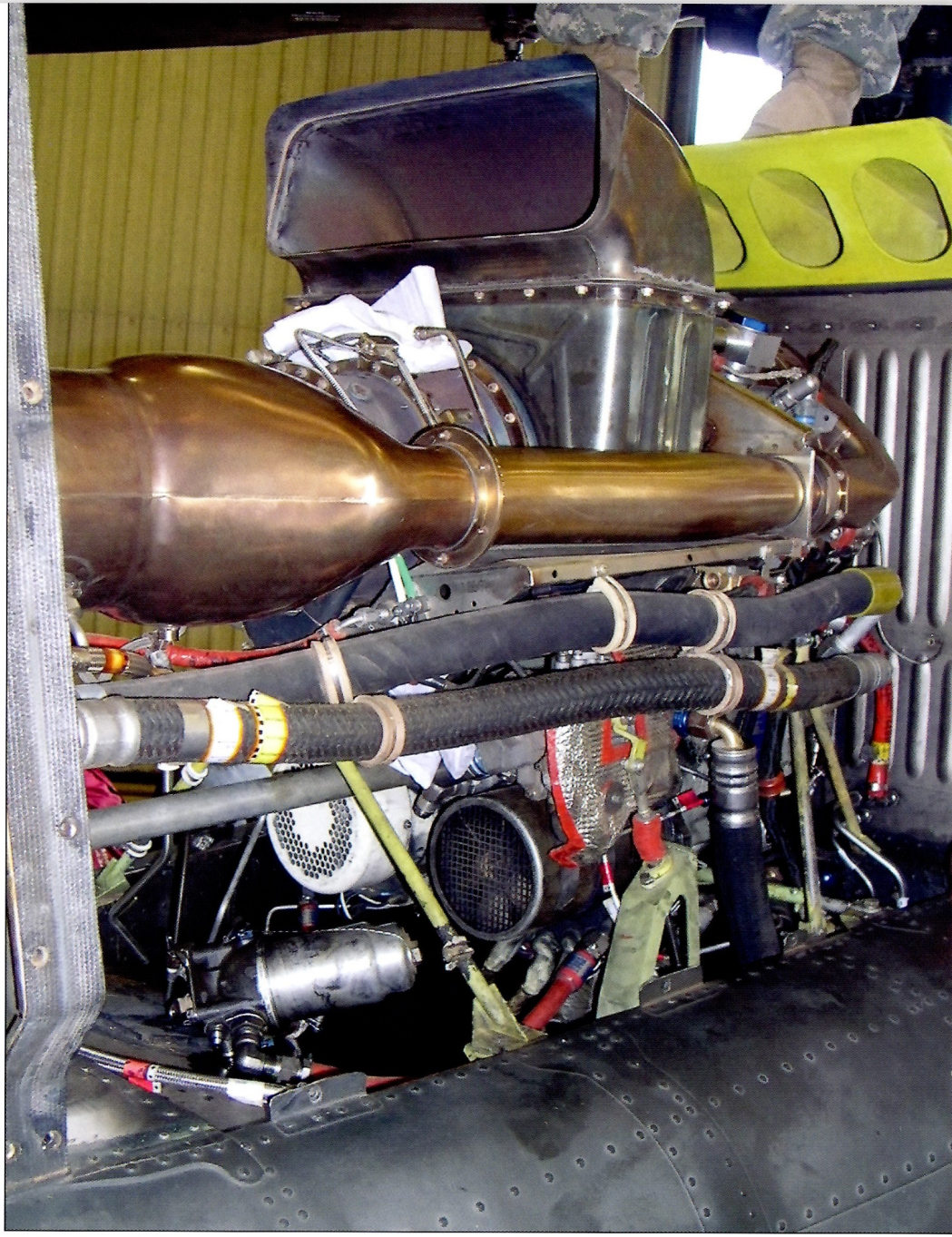
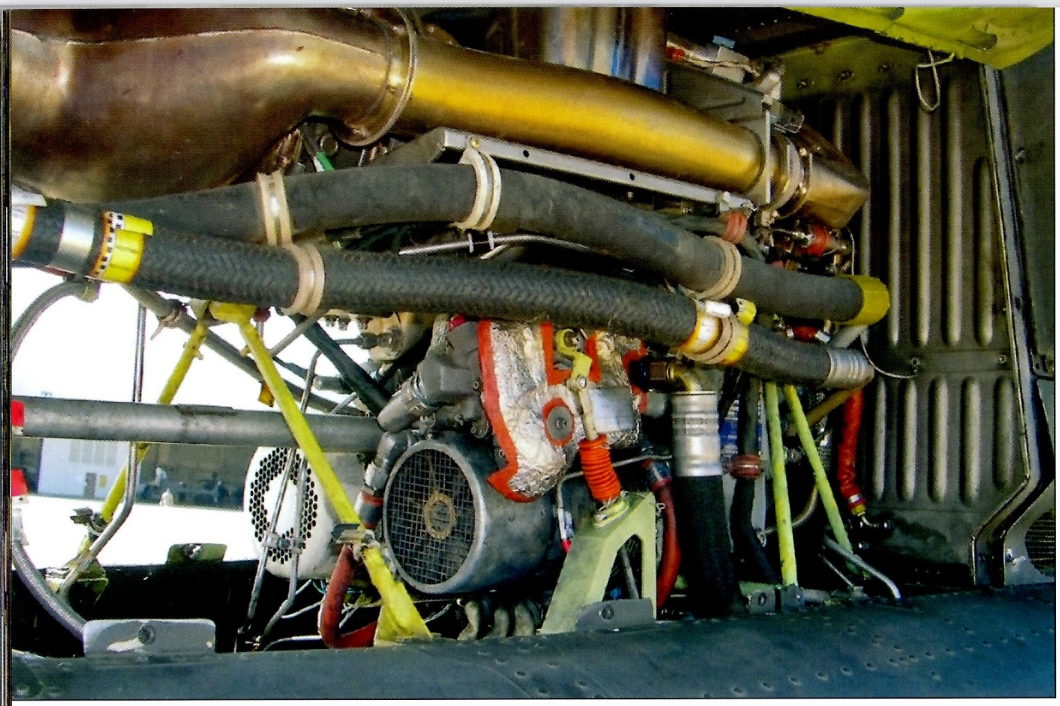


The combustion section, complete with fuel nozzle (orange line) and igniter plug (silver line), is at the rear end of the engine. The engine weighs 274 pounds without fluids and is 43.198 inches long, 25.130 inches tall, and 21.996 inches wide. Fuel flow is controlled by the throttle. On a turbine helicopter, the throttle is always full open and the power requirement is met by the governing system, which uses the collective position and application to meter the fuel to the engine.



This engine has the upper cowling removed to show how the engine exhaust leaves the aircraft. Under the engine, at left, is the white 115V AC generator. An oil filter is sitting on the engine deck and not in its normal position between the AC generator and the starter/generator, which has a visible cooling fan. The starter/generator puts out 200 amps of 28V DC power. A soldier is standing on a built-in work platform.

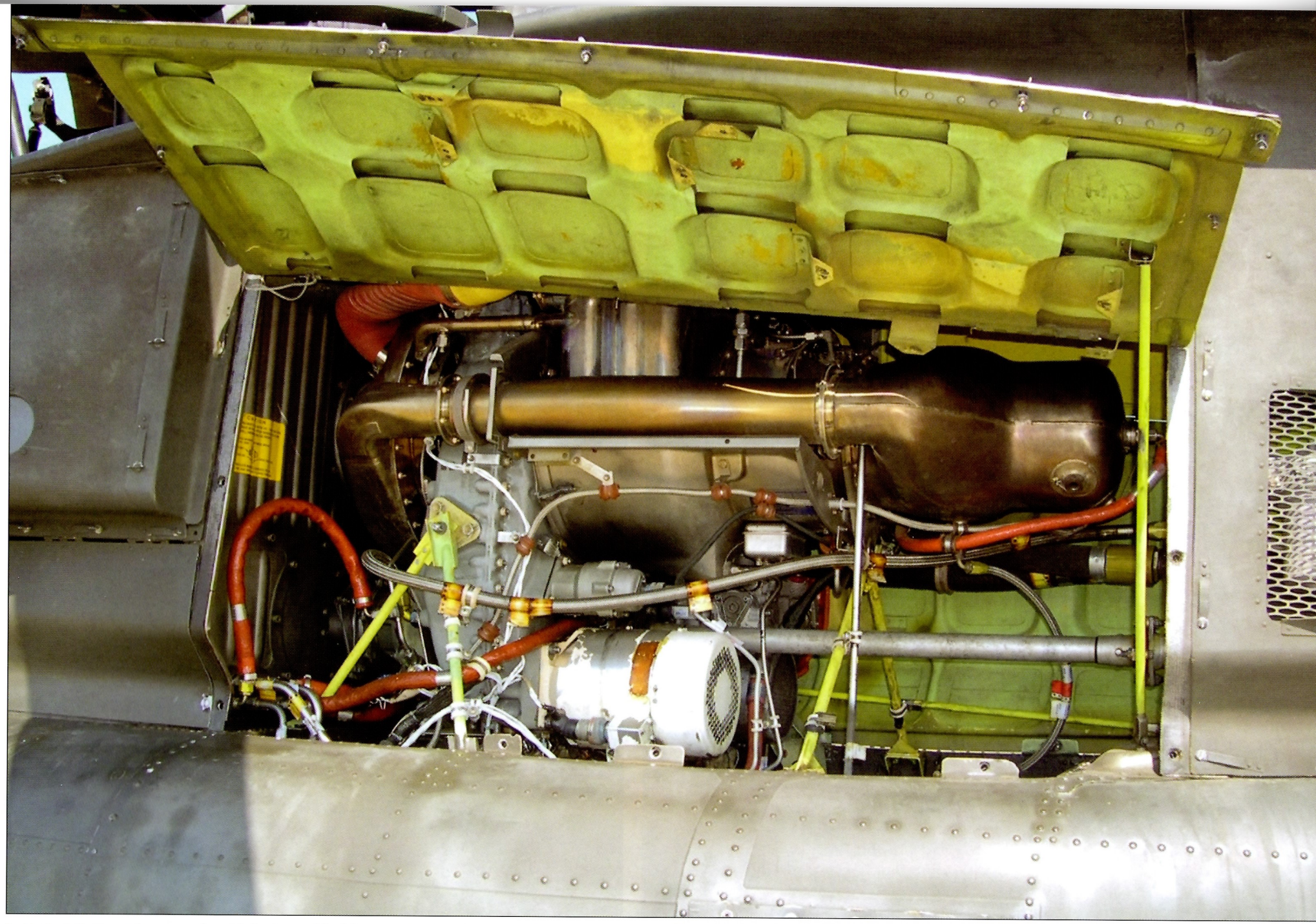


Between the AC generator and the starter generator is the line for the oil filter. The aft mount straddles the tail rotor driveshaft and is painted a zinc chromate yellow. The forward engine mount is a bipod mount on the front right side of the engine. The large black main fuel line goes into the fuel control with the actuator control arm just aft of it.

After a sandstorm caused by a shamal, a desert wind, a Kiowa Warrior looks like it is camouflaged sand brown, but this is just a testimony to the amount of dust one of these storms kick up. The storms block out the sun when at their height. This unfortunate crew chief left the doors off, so the aircraft is caked with sand inside and out.

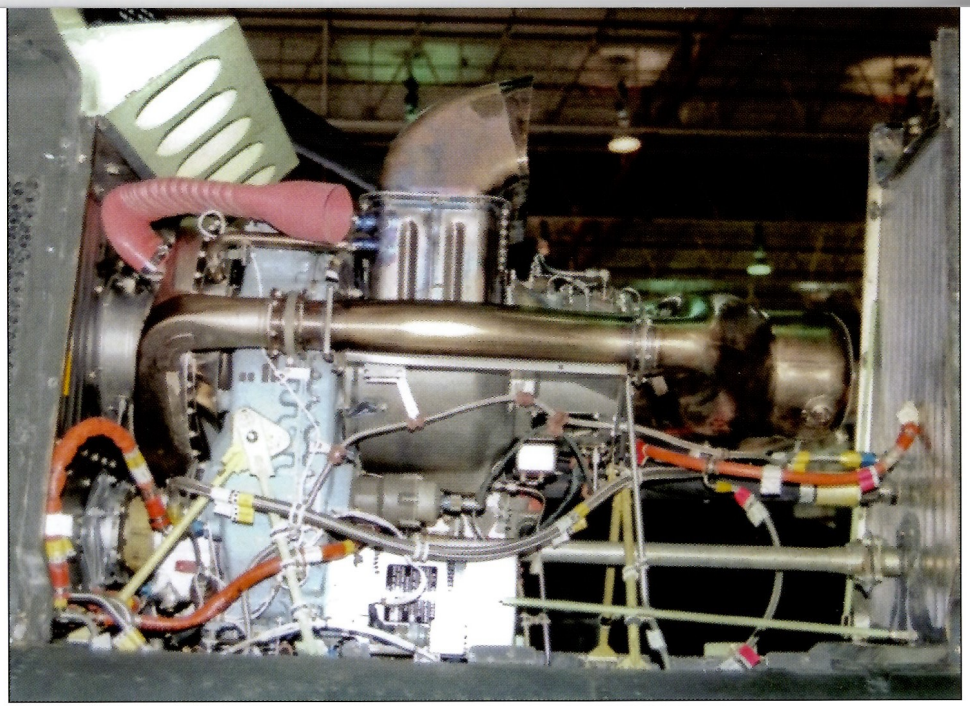
A Warrior has set down in a marsh plain in a lush part of Iraq, the Tigris-Euphrates Valley. Emblazoned with the name “Dirty Deeds,” this helicopter is covered with sand and dirt. These austere conditions are hard on man and machine. Despite this, the Kiowa Warrior has exceeded 300,000 combat hours since the Iraq invasion. This speaks volumes about the mechanics, crews, and support personnel.

Even under harsh conditions, the crew chiefs are hard at work keeping their charges ready for combat. A water truck with a compressor allows for quick cleanup of the exterior of this Warrior. Despite these conditions, a readiness rate in excess of 92 percent is testament to the hard work and determination of the maintenance personnel, without whom the aircraft would be nothing but brown lawn ornaments.



Inside the left side engine compartment is the large white AC generator. Above that is a tach generator. The air discharge tubes running to the combustion section are prominent in the compartment. A yellow and green zinc-painted bipod engine mount is on the accessory gearbox. The Kevlar protection has been removed, which indicates that this aircraft is in the United States. The orange spaghetti lines are for the free-wheeling unit, and the long braided silver line supplies high voltage to the igniter.

The left engine access door has provisions for Kevlar panels to protect the compressor and combustion sections of the engine. These are sometimes removed while training in the United States. A support rod at the rear of the engine compartment keeps the door open.

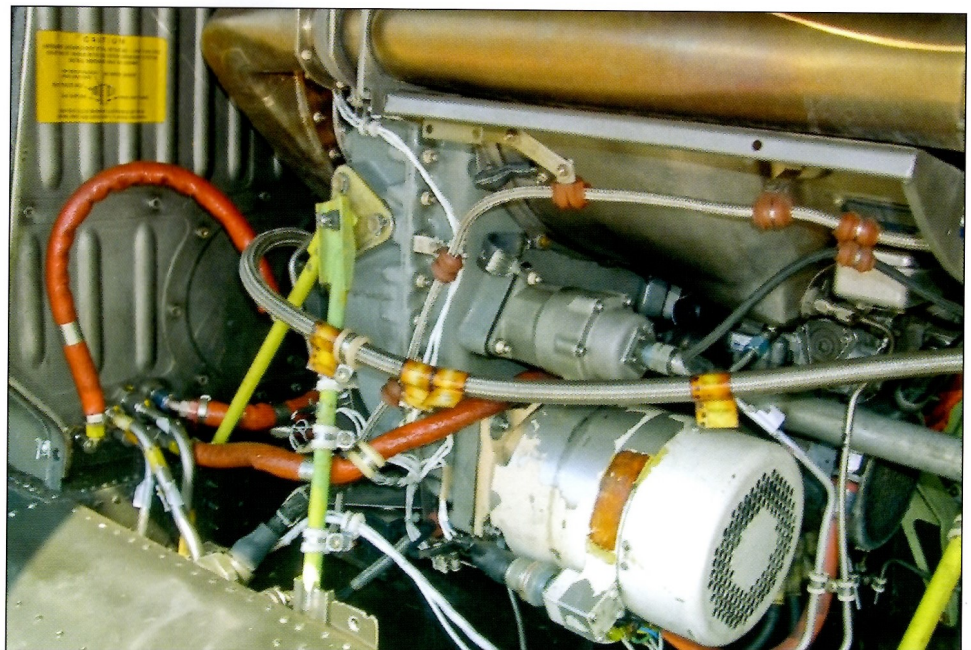


The entire engine assembly can be seen with the upper cowling removed. Swirl tubes for the air inlet are on the left in the photo, and at the right is the oil cooler compartment. The engine drives the fuel pump, fuel control, the oil pumps, and the starter generator, as well as the main and tail rotors. Power from the engine is transferred to the transmission by a driveshaft, which can be seen under the orange hose on the front of the engine.

The left side of the Rolls-Royce Allison C250-C30R/3 shows the large gray accessory gearbox used for mounting various components. All the orange tubes are used for lubrication. The orange duct work above the engine is connected to the engine barrier filter, which provides more air when the engine needs more power.

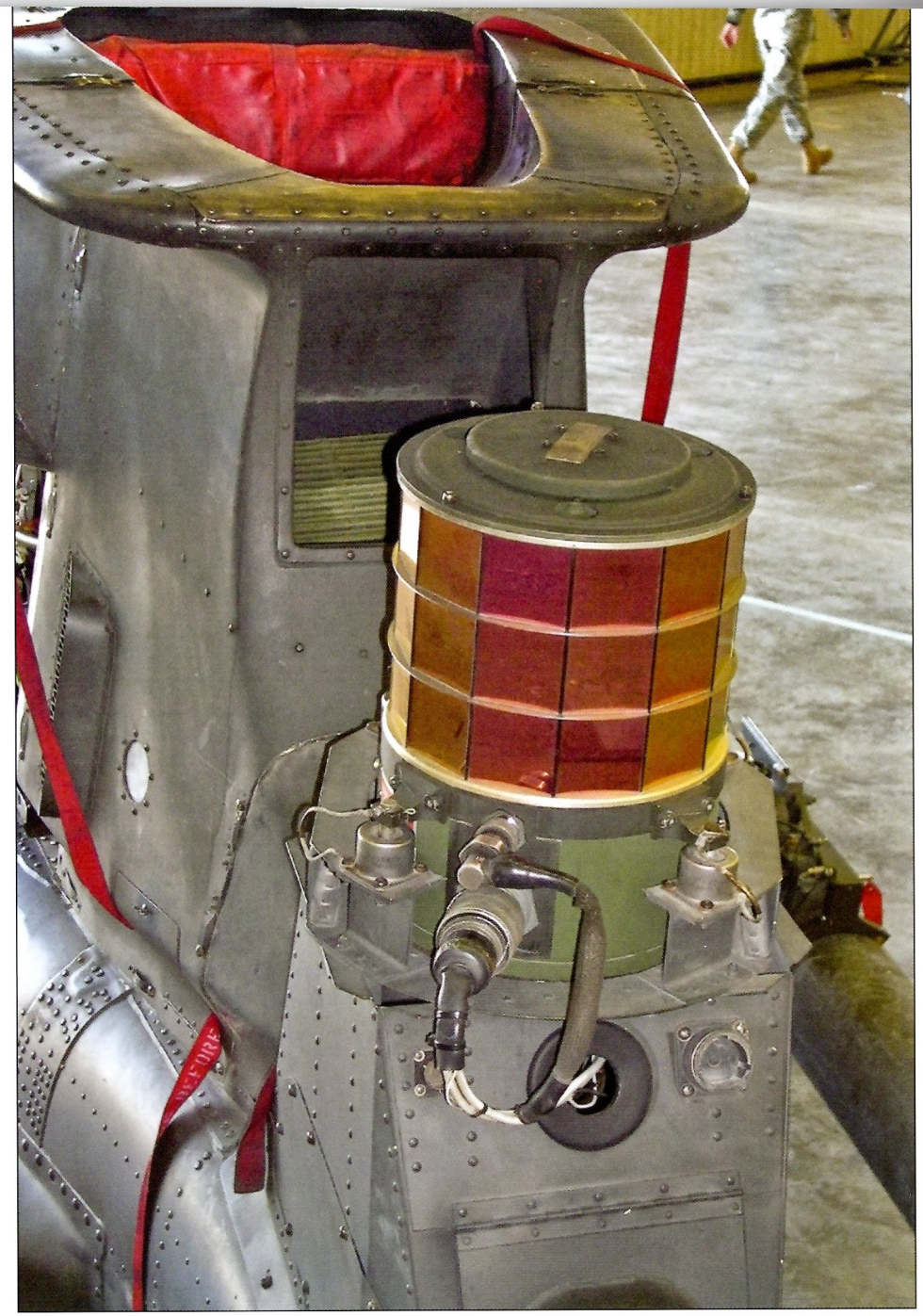
The upper engine cowling has a heat shield for the engine exhaust. The different colors, one zinc chromate and one fluorescent chromate green, of the bipod mount and the aft engine mount are typical. These parts can be either color, as can the area around the transmission.

The numerous engine lines and the design of the cowlings make changing the engine a full day's job.



The rear part of the engine compartment acts as a bulkhead and firewall. Exhaust gases have discolored the upper part of the compartment. Thomas couplings attach the tail rotor driveshaft to the firewall.

From the left side, the power connectors for the ALQ-144(V)3 infrared countermeasure set can be seen. The ALQ-144 is an active, continuous-operating omnidirectional jamming system used to confuse infrared missiles. The mirrorlike windows are called covert windows. The system is a self-contained unit. The black plug mounted on the back side of the pedestal is a stop for the tail rotor driveshaft cover.



The oil cooler can be seen in the open area behind the ALQ-144. This FOD pillow is installed in the exhaust to keep birds and debris out when the aircraft is on the ground. The cover has long streamers to alert crews that it is installed. Even so, occasionally the pillow is left in, and when the engine starts, it pops out on fire, leading to a lot of ribbing from the ground crew. Other than a burning pillow, this causes no other damage.

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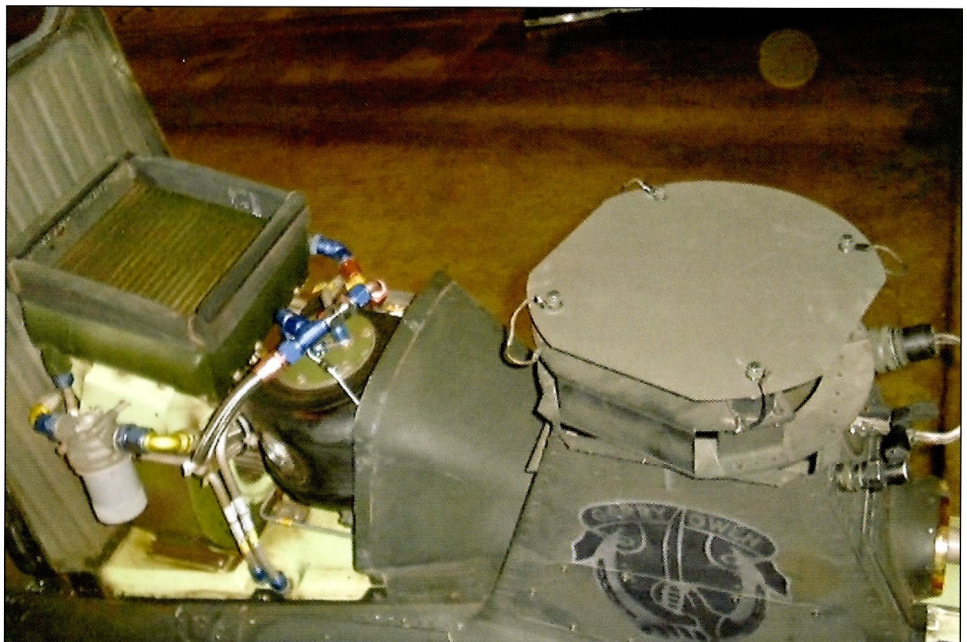
Early Kiowa Warriors had this ALQ-144 mount. This aircraft shows the configuration of the MPLH gear. The landing gear are zinc chromate and the ALQ-144 mount is a noticeably different color, indicating that they were added after the helicopter was manufactured.

The asymmetrical blanking cover plate for the ALQ-144 is installed when the aircraft flies and the ALQ is removed for maintenance. If the craft has no ALQ, then one of these covers will be installed in its place. The plate is mounted on top of the isolation mounts. With the unit removed, the connector plugs are attached to blanking connectors so they don't damage the airframe. The pedestal is often a canvas for unit insignia, such as this insignia for the 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division. Removing the aft cowling reveals the oil cooler and associated reservoir and plumbing.



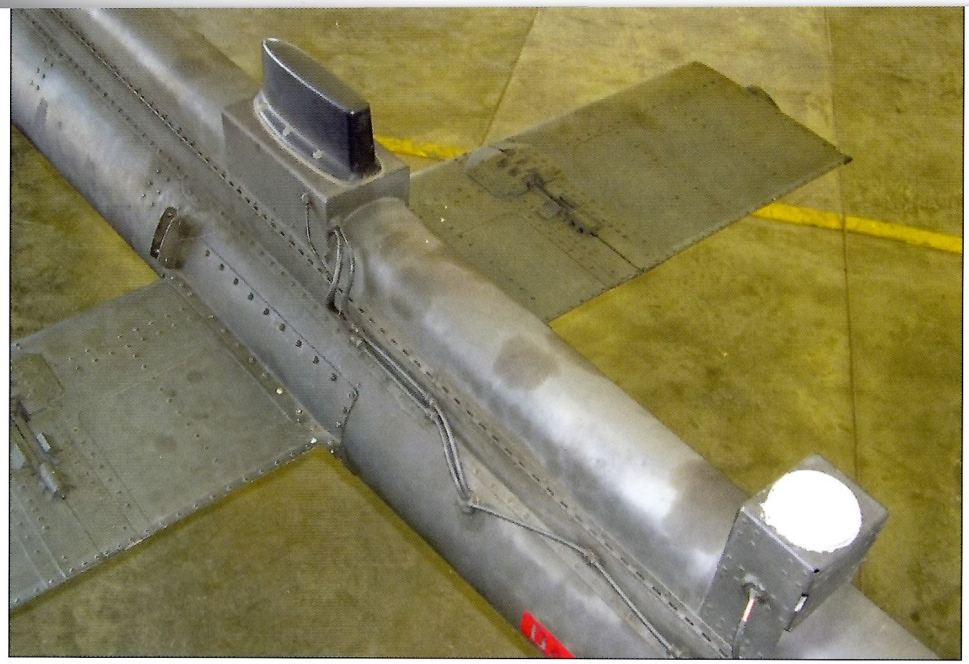
When on the ground, the ALQ-144 is protected from damage by a cover that is secured with a Velcro strip. It has a "Remove Before Flight" tag.

The tail rotor's leading-edge erosion guard is often painted over; however, these new blades show no sign of wear yet.

The tail boom of the Kiowa Warrior provides a mount for fixed horizontal stabilizers, tail rotor gearbox, and the vertical fin. An HF antenna mount is under the tail boom. It is frequently removed and, when present, is often noticeably bent. It is nothing more than a hollow tube. (*Louis Chang*)

The tail rotor blade has an asymmetrical cross section. The blade is constructed with a fiberglass skin and a stainless steel leading edge strip. This strip is sometimes sprayed with flat black paint to prevent erosion caused by sand. The tail rotor turns at 2,381 rpm and is 5 feet, 5 inches in diameter with a chord of 6.35 inches. The bare metal area next to the gearbox is used for inspection, because this area is prone to cracks.

The vertical fin is mounted slightly offset to help compensate for torque during forward flight. An infrared light is mounted on top of the tail cone and is accompanied by a normal clear navigation light in the rear, providing illumination under all conditions. While NVGs are used, the normal system is turned off, leaving the aircraft "invisible" to the naked eye. (*Louis Chang*)



The tail boom provides mounts for various antennas. The white disk is the antenna for the GPS. The semiairfoil-shaped antenna is the Blue Force antenna. Introduced in 2005, the Blue Force antenna provides positioning information on the digital battlefield and is intended to prevent friendly fire incidents. Blade folding mounts are just in front of the horizontal stabilizer and are occasionally painted red. Under the front of the tail boom is one of the APR-39 blade antennas. The HF antenna runs the length of the tail boom but is frequently removed.

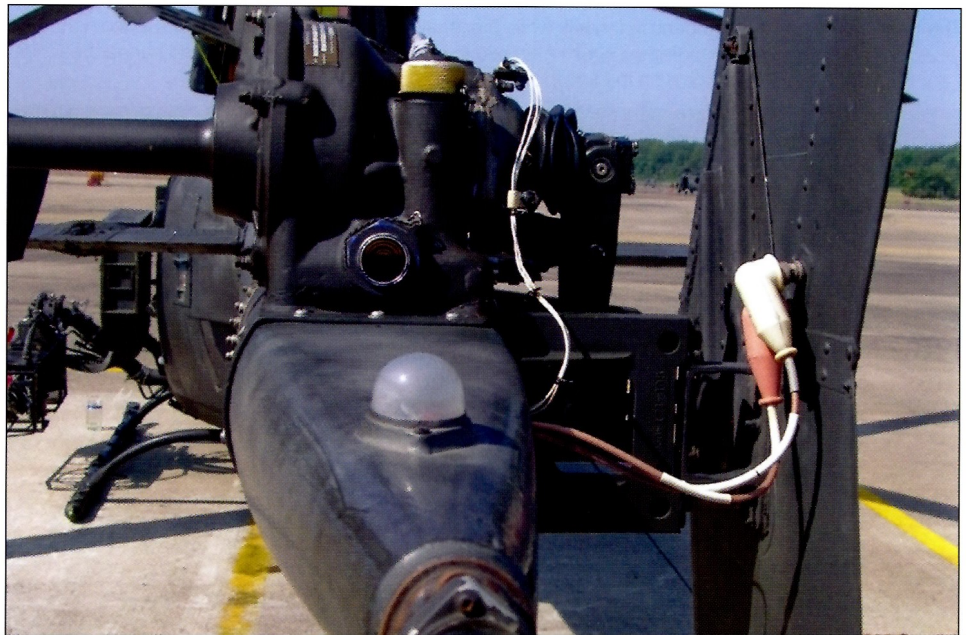
The tail boom is a full monocoque structure, meaning it has no stiffeners inside. The tail rotor pitch controls run the length of the boom inside. The tail rotor driveshaft is located under two tail boom access covers. The front cover, the largest, opens to the left, while the smaller one by the tail rotor opens to the right. The driveshaft consists of seven individual shafts attached to one another by disk packs and hangar bearings. Four hangar bearings are visible on the tail boom.

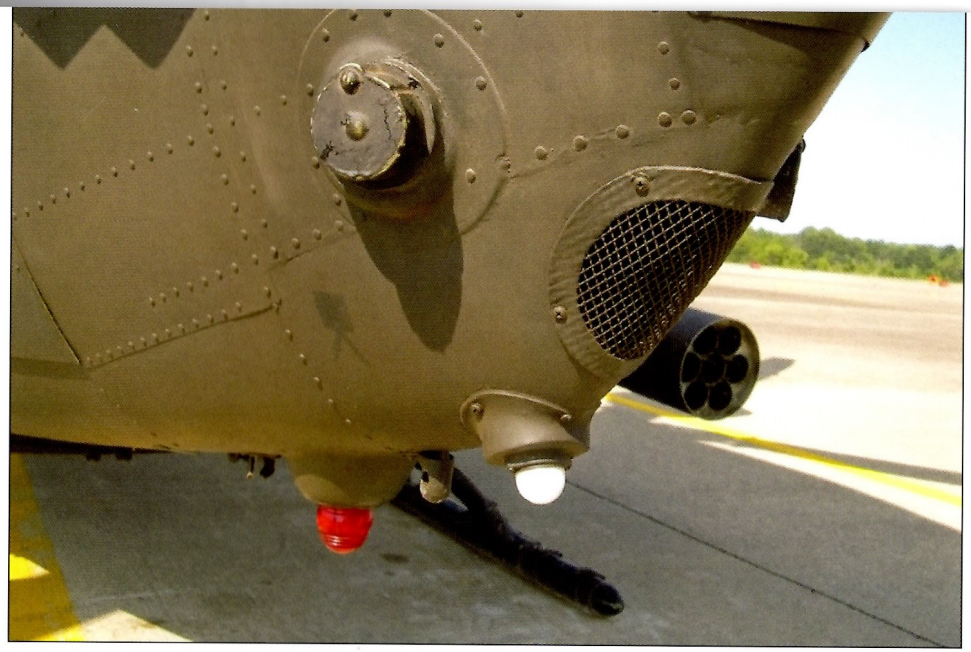
On the Warrior, the vertical fin serves several functions. It houses the FM-1 and the UHF/FM antennas (on top of the fin), as well as the tail skid. The tail skid is often called the automatic leveling device and aids the pilot when in a tail-low condition. Its purpose is to keep the tail rotor from hitting the ground. The tail skid has 24.03 inches of ground clearance when level. The vertical fin can be loosened and rotated for squatting. Early aircraft required the vertical tail to be removed.

The horizontal stabilizer is a negative airfoil designed with folding tips. On the end of the outboard portion of the horizontal stabilizer, between the light and the airfoil, an additional weighted panel has been added to help alleviate a problem of cracks in the tail boom. The stabilizers are folded by removing the expandable bolts on the bottom of the airfoil and then rotating them up to slightly over 90 degrees. They are frequently held in place with duct tape when shipping.

Colored lenses are used on the tips of the horizontal stabilizers, red on the left and green on the right. The front portion is painted over to help with NVG operations when the lights are on, typically in training and not combat. The negative airfoil of the stabilizer is designed to put a downward force in flight and expands the center of gravity range of the helicopter.

The tail rotor gearbox reduces rpm and provides a 90-degree change in direction of the tail rotor drive. The gearbox is a self-contained splash-type lubrication system. The system is lubricated by DOD-L-85734 oil and has a capacity of 0.39 quarts. A yellow cap on the back of the gearbox allows access for adding oil. The gearbox is equipped with a chip detector and a temperature sensor. An infrared light is on the top of the tail cone, and a regular clear light is mounted on the aftmost portion. Connectors for antennas can be seen on the vertical fin. The vertical fin is folded by removing two bolts, loosening the other two, rotating the vertical fin forward, and reinserting the bolts to lock it in place.



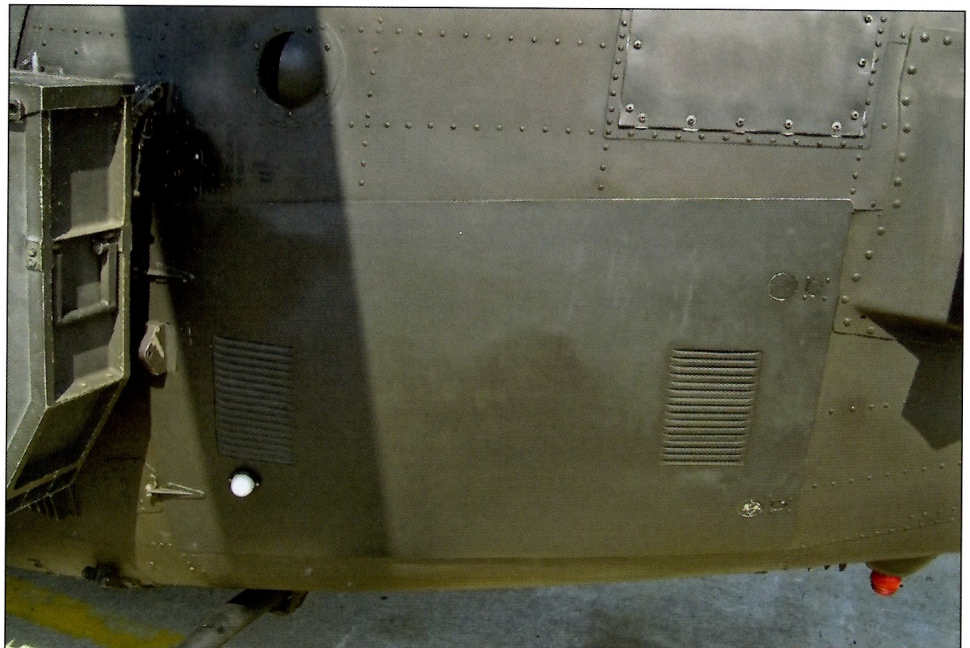


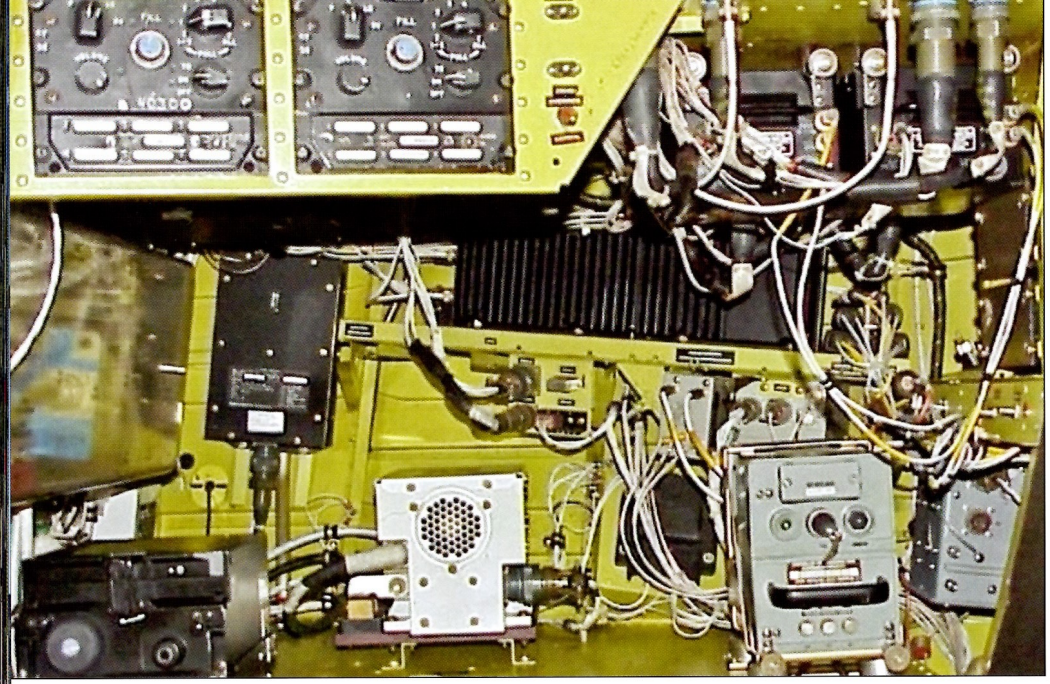
The aft lower portion of the fuselage houses an anti-collision light, an infrared formation light and a jacking point between them. The APR-39V/2 antenna is semigloss black and warns of radar-guided missiles. The screen vent is for cooling the avionics compartment.

The avionics access door has two sets of cooling vents and two cowl locks at the aft end to keep the door shut. An infrared formation light is incorporated into the door on the left side for visual reference in flight while using NVGs. A tail rotor control access panel is located on the fuselage and allows the crew chief access to various tail rotor controls. The ram air inlet above the avionics door is used to cool back-seat electronic components.

An OH-58D(R) from the Bounty Hunters, E Troop, 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division, takes off from Comanche Base in Tuzla, Bosnia, in 1998. The SFOR markings are on the aft avionics door. The aircraft sports the Garryowen unit crest on the left side of the ALQ-144 pedestal.

The avionics door is simply a piece of formed sheet metal with internal stiffeners. In this case, it is painted yellow zinc chromate, but it can also be painted the same color as the inside of the avionics bay, which is a fluorescent green epoxy primer. The two electrical cables for the infrared light are at the front of the door. The avionics door has been known to open on its own when the .50-caliber machine gun is fired. Pilots learned quickly not to put anything of value inside the avionics compartment.



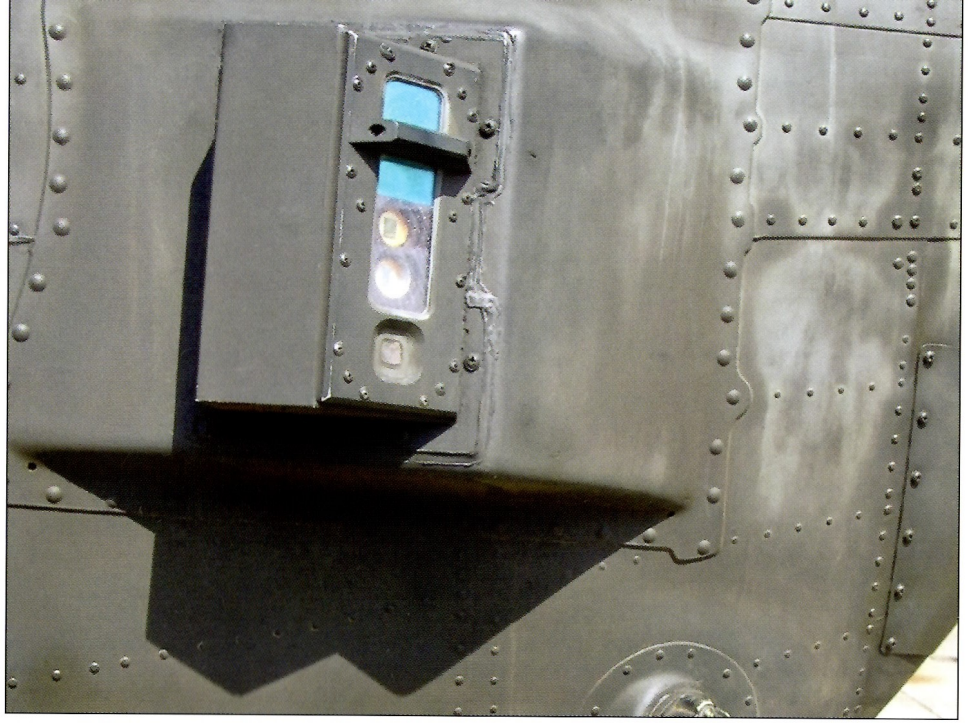


The inside of an early Kiowa Warrior avionics bay includes, clockwise from top left, two KY-58 communication security units, two FM radios, a 115V AC inverter, a KIT-1A IFF, a white Transformer Rectifier Unit, and a video recorder.

The front wall of the avionics compartment is dominated by the bus bar system. A clear cover protects the electrical components. Below the cover is the voltage regulator for the starter generator. The Warrior was the first Army aircraft to take advantage of the 1553 data bus to pass digital data between systems.

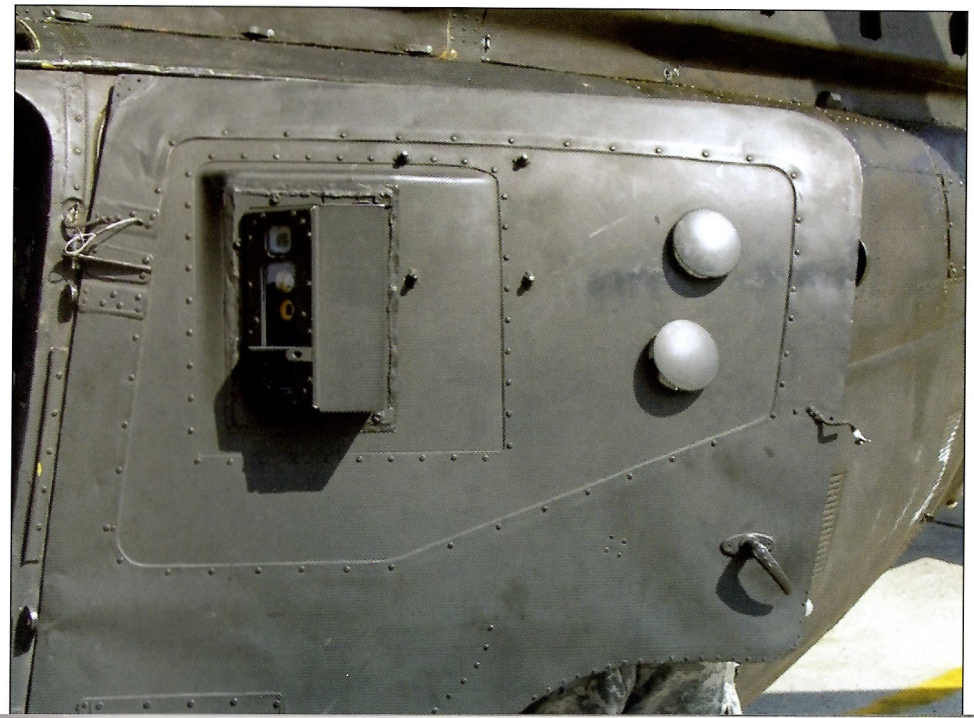
A modern Warrior avionics bay has the KY-58s removed and the FM radios replaced with ARC-201A single-channel ground-to-air radios. This deployed Warrior shows that every space that can be used for storage is used. The ALQ-144 cover makes a convenient holder for the blade tie-downs. A combat medic bag to supplement the first aid kit is in the background. The light-color item is a cover for the windscreen.

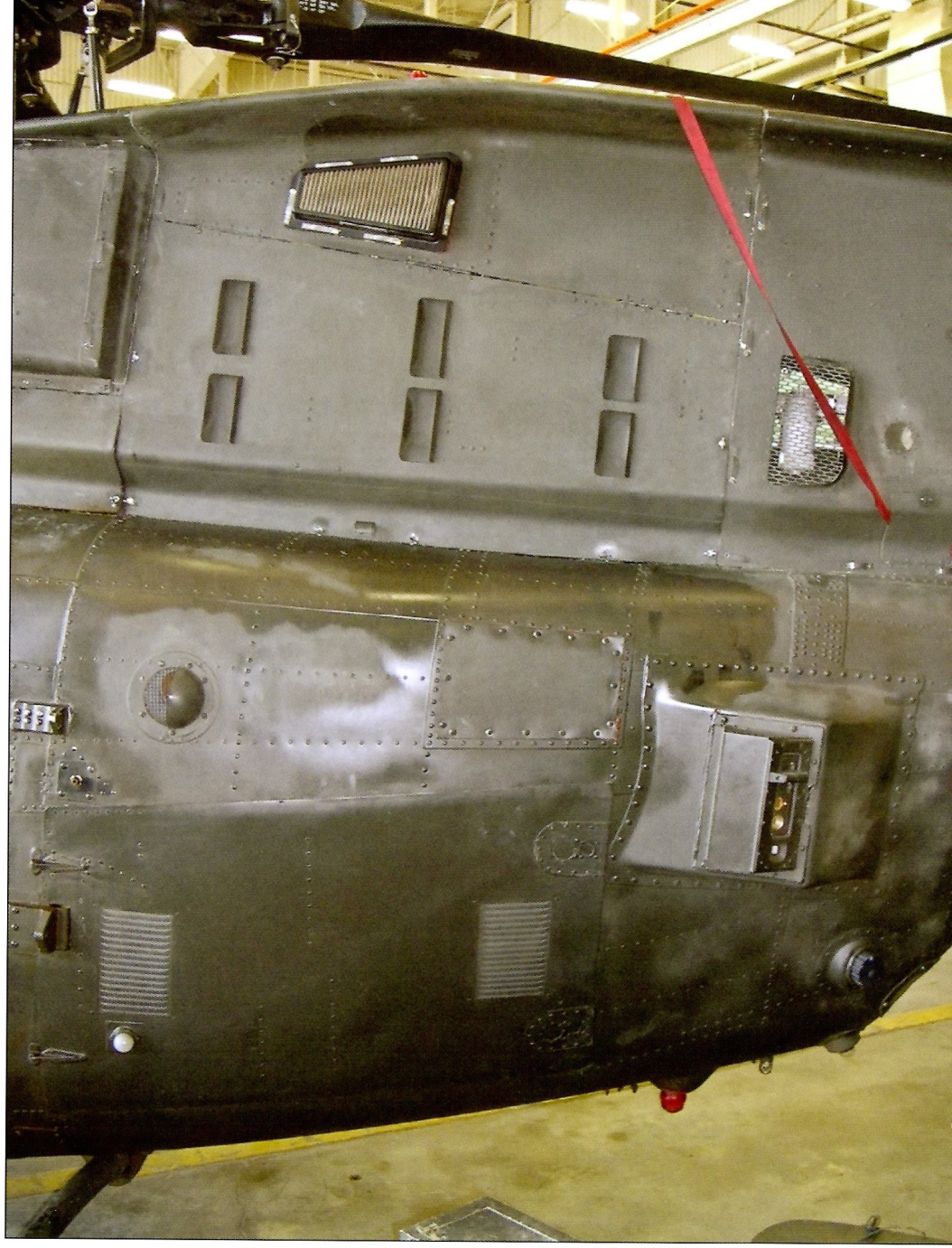
An aircraft of 1st Squadron, 17th Cavalry Regiment, 101st Airborne Division, shows how these aircraft fare during the war against terrorism. This aircraft has its AVR-2 laser detector antennas removed. The four AVR-2 mounts are covered by flat black blanking plates. The lack of the aft panel for the inlet housing is an attempt to keep the engine from being blasted by sand. (*Mark Vanderweyden*)



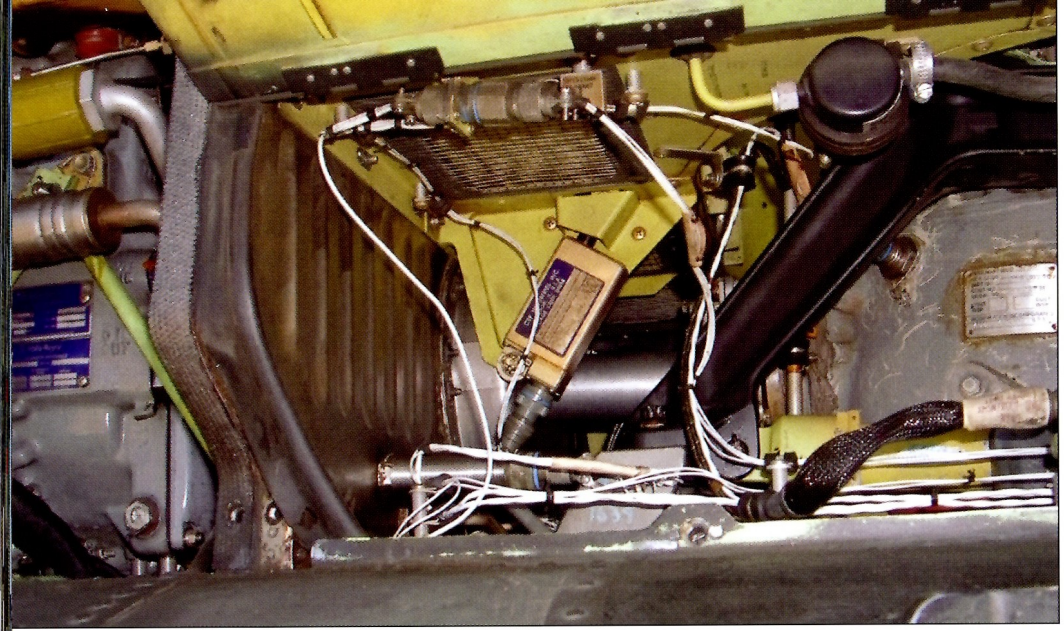
The left rear AVR-2 antenna shows how the system is mounted. Each AVR-2 is mounted differently and specifically designed for each location. The identifying key is the deflector bar on the windows.

The rear doors were modified in 2005 with the addition of another cooling vent. When the airbag system was added, the first aid kit was relocated to the door. Its four mounts can be seen just aft of the AVR-2.





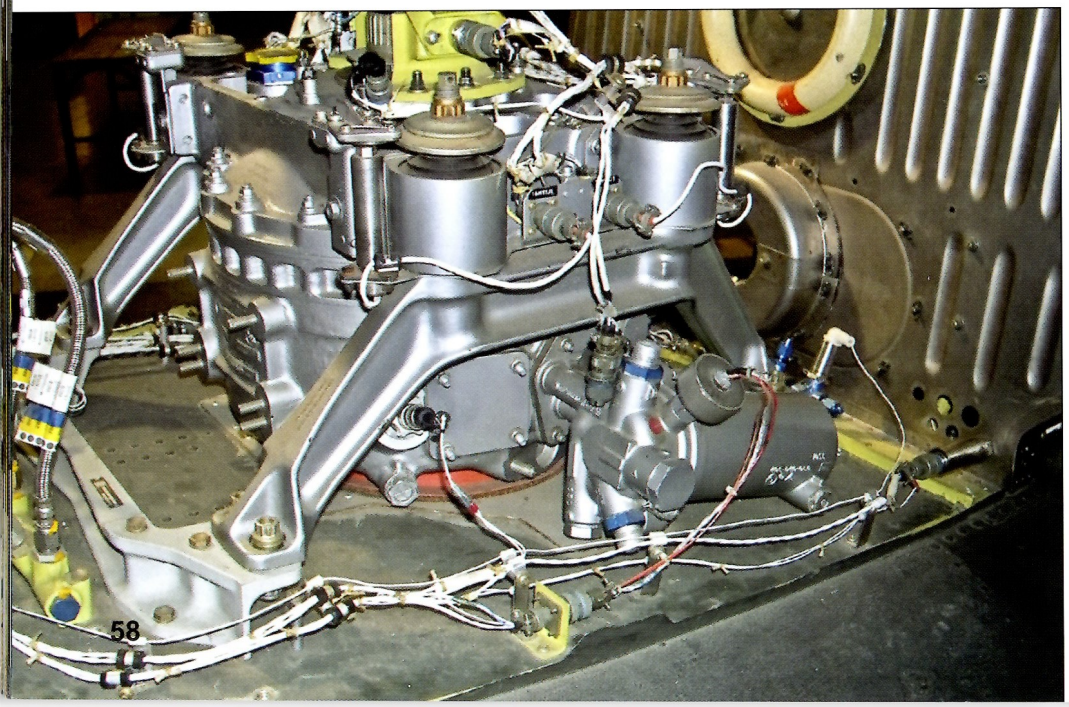
Crew members attempt to keep their helicopters clean, but sometimes, despite every effort, they become a mess. This aircraft has a beautiful sheen below the engine deck. This will attract dirt and sand in the desert. This overall view of the fuselage center section shows the engine barrier filter above the engine compartment. The oil cooler can be seen through the inspection and cooling port on the aft cowling.



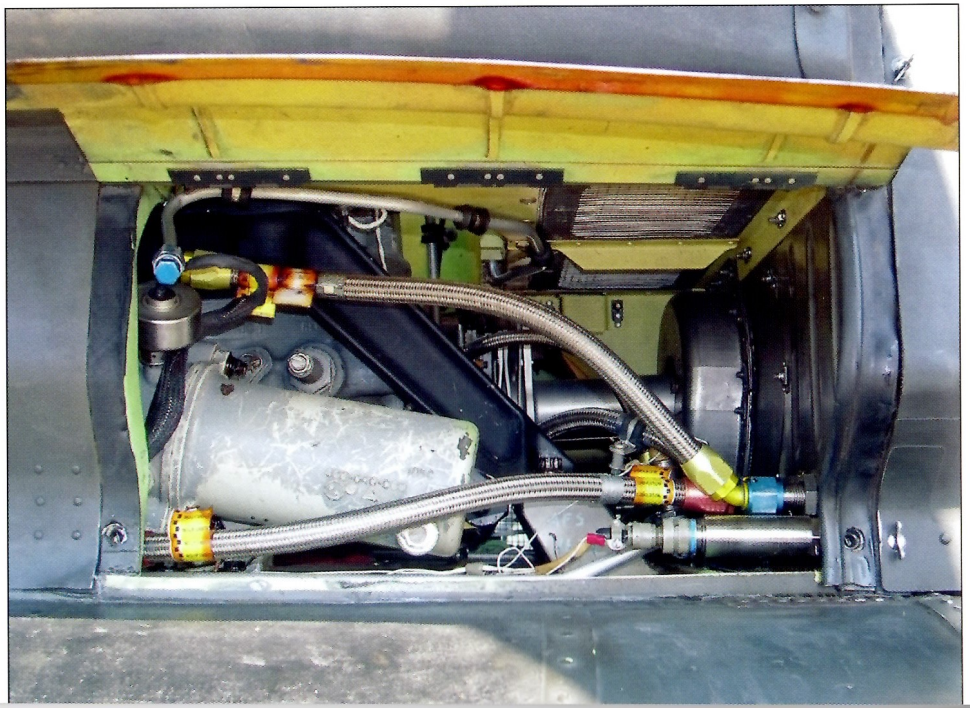
The upper inlet filter is inside the right transmission access panel. The transmission transverse mount is the black object leading off at an angle with the gray transmission behind it. The metallic tail rotor driveshaft, called a K-flex driveshaft because it was designed by Kamatics Corp., is in the background.

The access panel on the right side of the transmission allows air to be blown overboard and permits inspection of this vital piece of equipment. Earlier Warriors had a flap and blower inside, and when the blower stopped at shutdown, the flap closed, keeping out debris. With the new inlet filters and engine barrier filter, the need for a blower and the flap was eliminated, which saved weight. Saving weight is always important with any helicopter. Any weight saved can be turned into more ammo or more gas.

This transmission is mounted on a training aircraft at Ft. Eustis and does not have all the components on it; however, it does show the corner mounts and the Transmission Attitude Reference System, which sends information to the IMCPUs and keeps the MMS aligned.

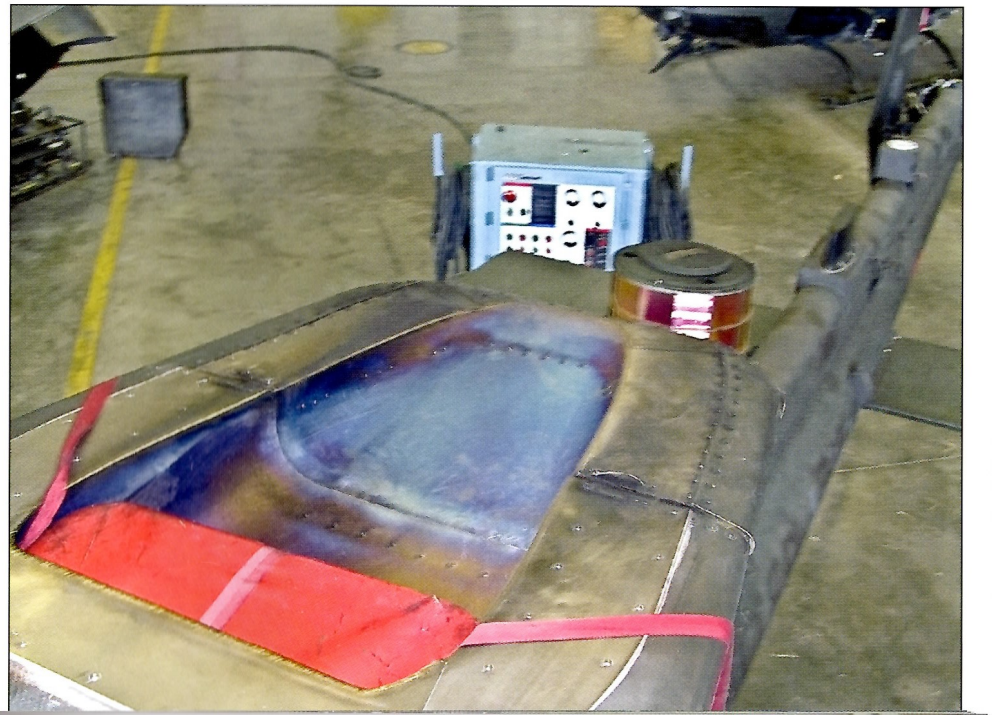


The transmission main oil filter housing, its temperature sensor, and associated wiring is inside the left transmission access panel. The silver braided lines are oil return and supply lines to the oil cooler, located in the aft engine housing. The transmission uses a splash type oil system.

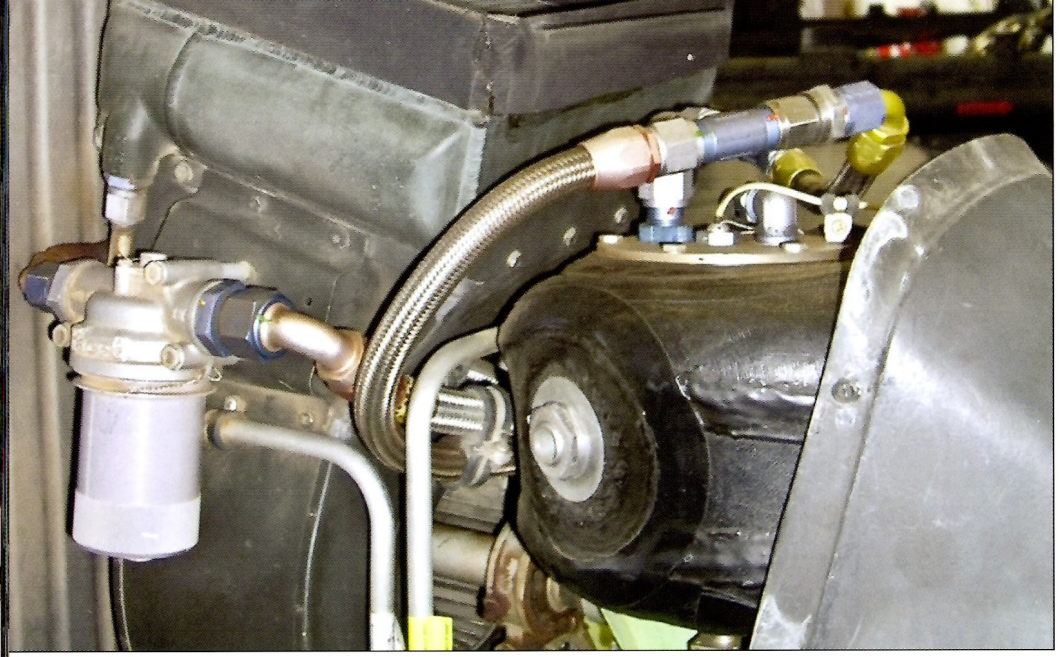


A switch in the cockpit allows the pilot to choose between normal, NVG mode, or off for the newer type of infrared anti-collision lights.

The engine exhaust heat shield is attached in two parts, which have distinct color patterns in the metal. The aft fairing is made of fiberglass and aluminum alloy, and allows access to the engine oil tank, oil cooler blower, and oil cooler without having to remove the ALQ-144. Because the exhaust vents out of the top of the engine, the rotor blades dissipate the heat to a level that is difficult for infrared missiles to track. A FOD pillow is installed with its streamers hanging over the side of the aircraft.

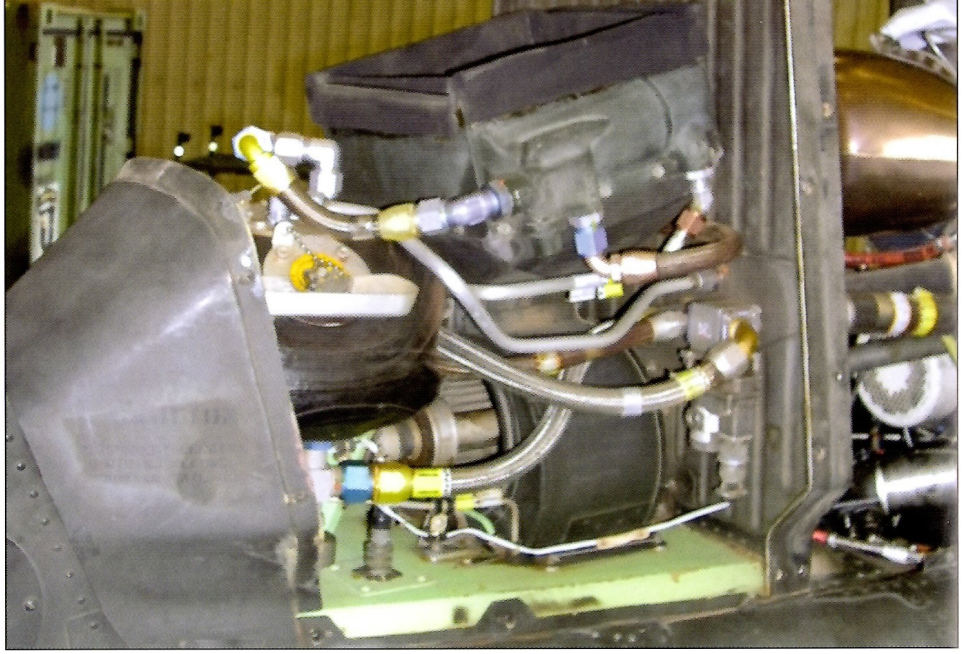


Soldiers performs maintenance on the MMS and transmission of a 2nd Squadron, 17th Cavalry Regiment, 101st Airborne Division, Warrior at Ft. Campbell, Kentucky. These mechanics are about to lift the MMS off the craft. New air filters go in the opening the mechanic is using.



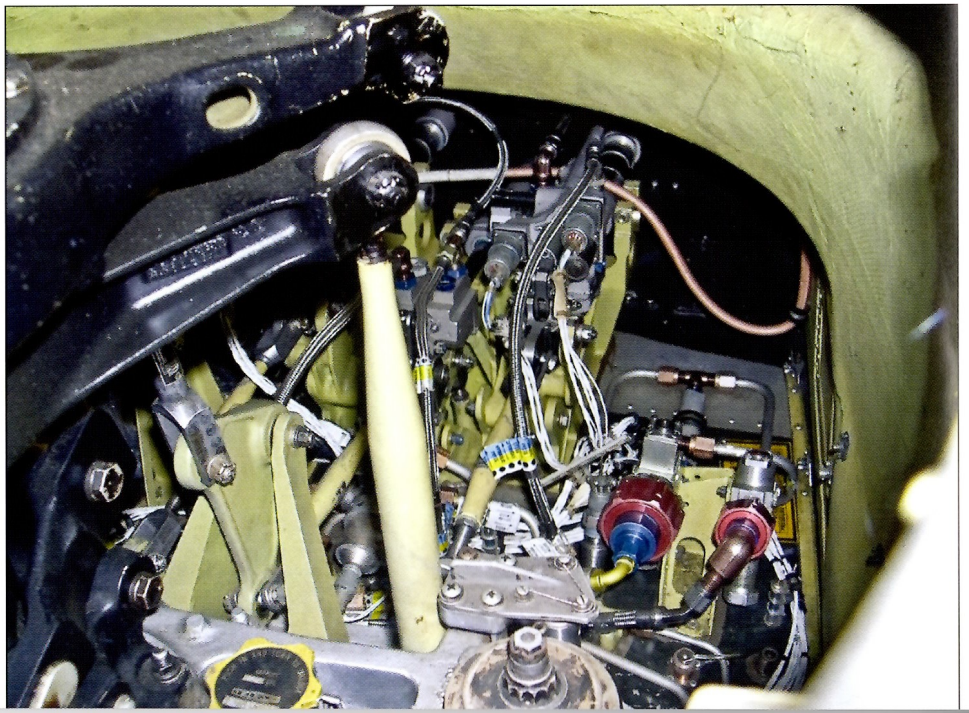
The oil filter assembly for the engine is on the left side behind the aft fairing. An impeller blower sends air up through the oil coolers. A hangar bearing to keep the driveshaft aligned is just outside of the blower. A sight glass on this side is used to check the oil level without opening the cap. This is especially important in the desert, where sand can cause a variety of problems.

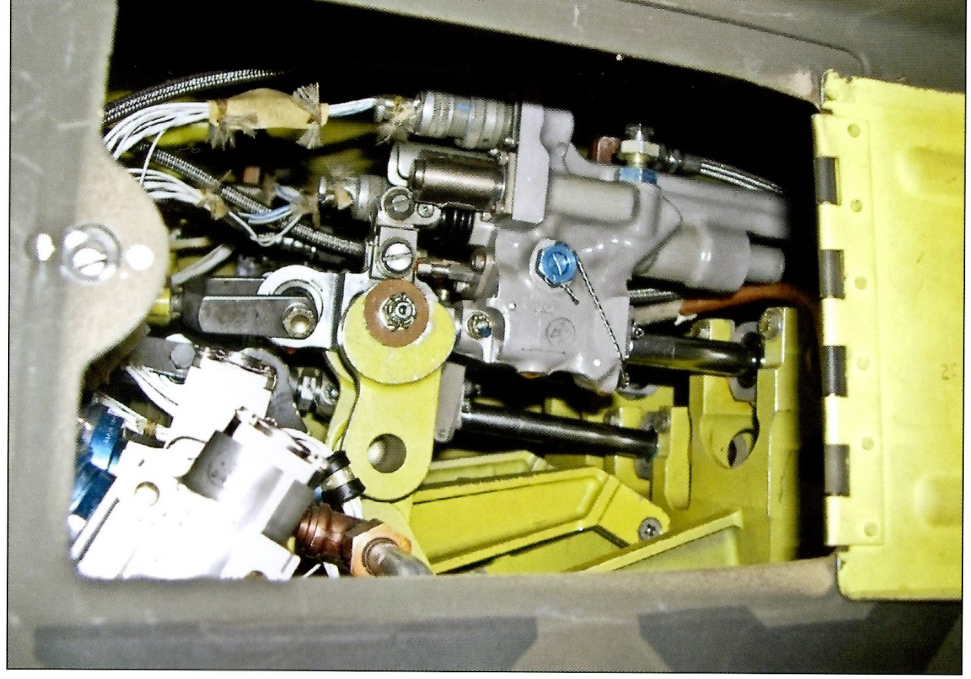
An inspection panel for the hydraulic actuators is on the right side of the forward cowling. A smaller inspection panel is on the bottom of the cowling on the left side. “The Judge” is a 2nd Squadron, 17th Cavalry Regiment, aircraft.



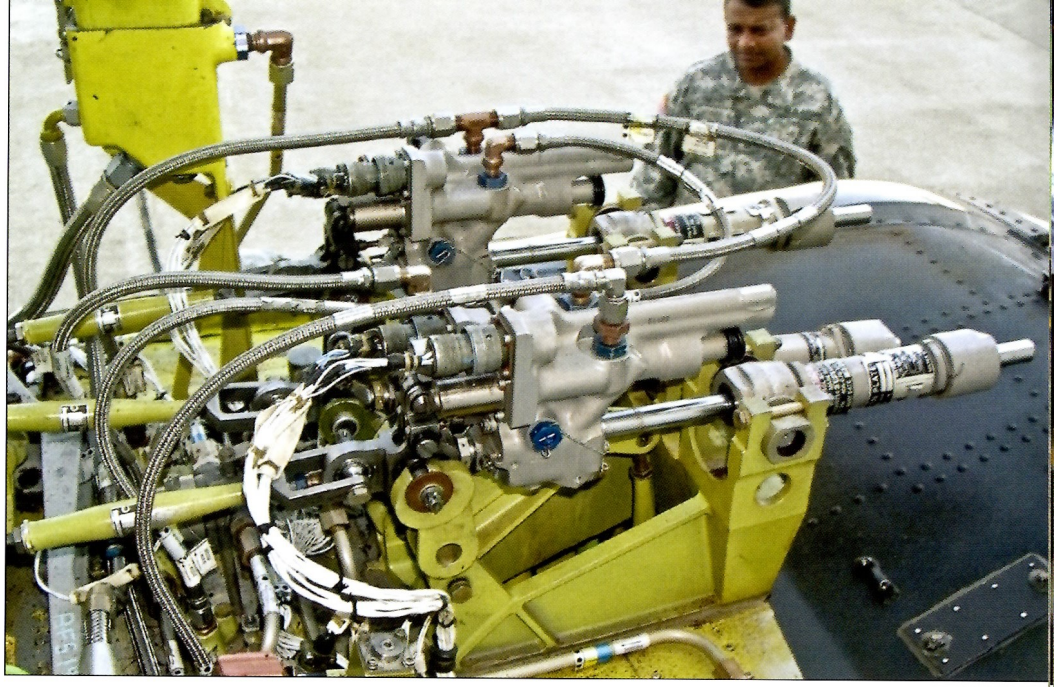
The oil cooler is visible with the aft fairing removed. The cooler is actually two coolers, one for the engine and one for the transmission, welded together. Air comes from a blower driven by the tail rotor driveshaft and is pushed out of the opening in the aft panel. The oil reservoir is rubber, self-sealing, and holds 11.2 pints of MIL-L-23699 oil. A yellow filler cap is on top of the reservoir.

Hydraulic actuators are visible toward the front of the helicopter when looking down through the opening for the transmission and main rotor mast. Push-pull tubes extend up from between the seats to control the main rotor pitch.



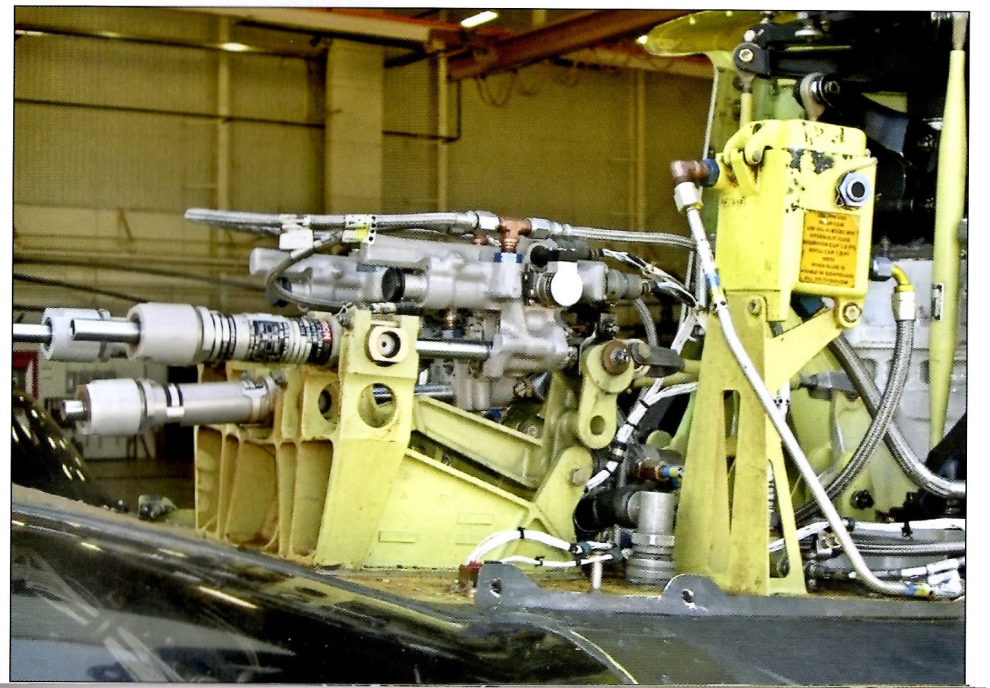


Hydraulic filters and actuators are visible with the inspection panel open. The filters are to the left of the opening, and the actuators are in the center. The actuators transfer mechanical movement into fluid motion. Another actuator is in the aft part of the fuselage for the tail rotor Stability Control Augmentation System.

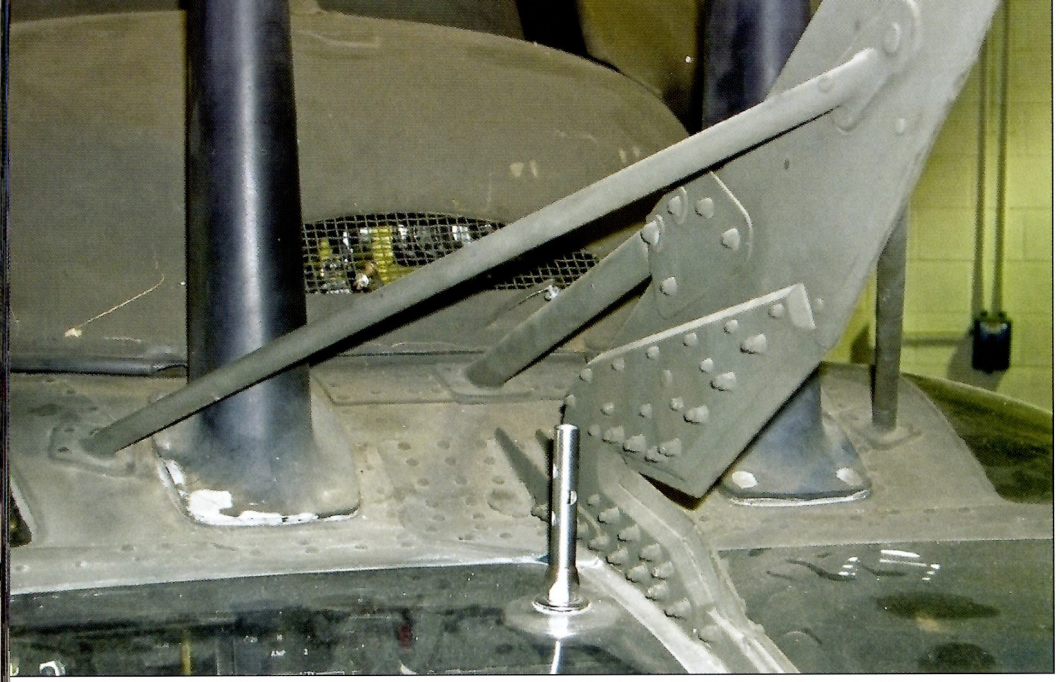


Seen from above, the hydraulic system looks like spaghetti but is very efficient. On the right side, the servicing red quick-disconnects allow mechanics to test the system with an Auxiliary Ground Power Unit. The cyclic actuators are on the outside, and the collective actuator is in the middle.

With the forward cowling removed, the hydraulic reservoir is visible on the left side of the aircraft. The system holds 1.3 pints of MIL-L-83282 fire-resistant hydraulic fluid. A hydraulic pump is attached to the transmission and provides a regulated pressure of 1,000 ± 25 psi to the entire system.



A Warrior leaves the Korea Training Center Multipurpose Range Complex with a 60-degree bank out. The hydraulics and the rotor system of the Kiowa Warrior make for an extremely maneuverable helicopter. The Army has placed restrictions on all helicopters of 60 degrees bank and 30 degrees up and down.

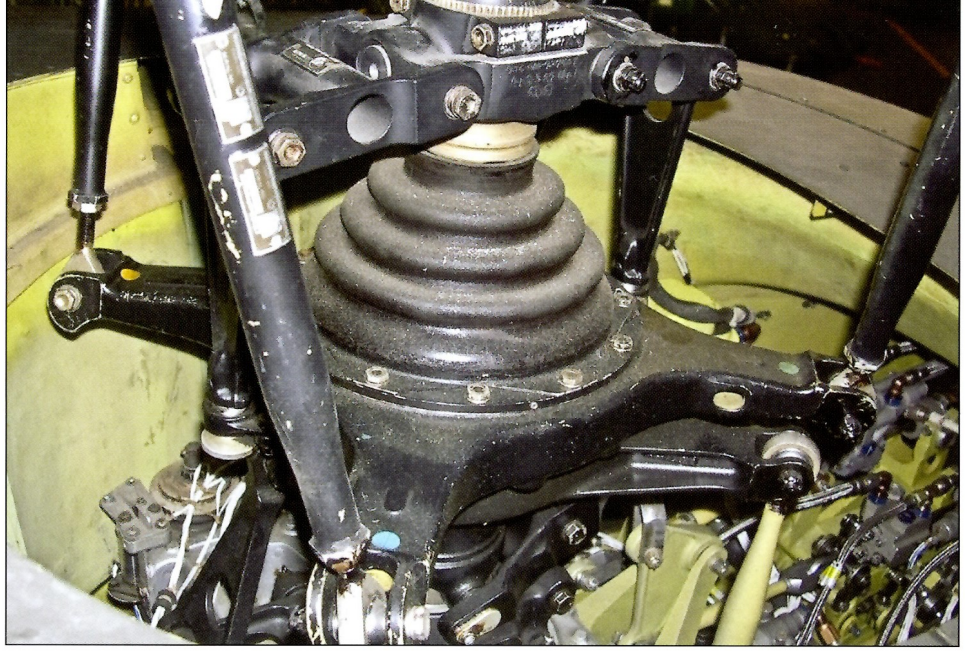


The Wire Strike Protection System (WSPS) consists of an upper and lower cutter assembly and a channel up the window. The WSPS is designed to drag the cable up the window to the cutters. A free air temperature gauge is mounted directly on the pilot's windscreen and has a silver protective sleeve.

The Upper WSPS cutter has three support beams, one directly behind it and two on the sides. This aircraft has one of the FM antennas removed to save weight. The tips of the FM antennas are usually bent up to aid in removing the forward cowling. This does not degrade the antenna. The hooks inside the cockpit are for the pilots to hang their helmets.

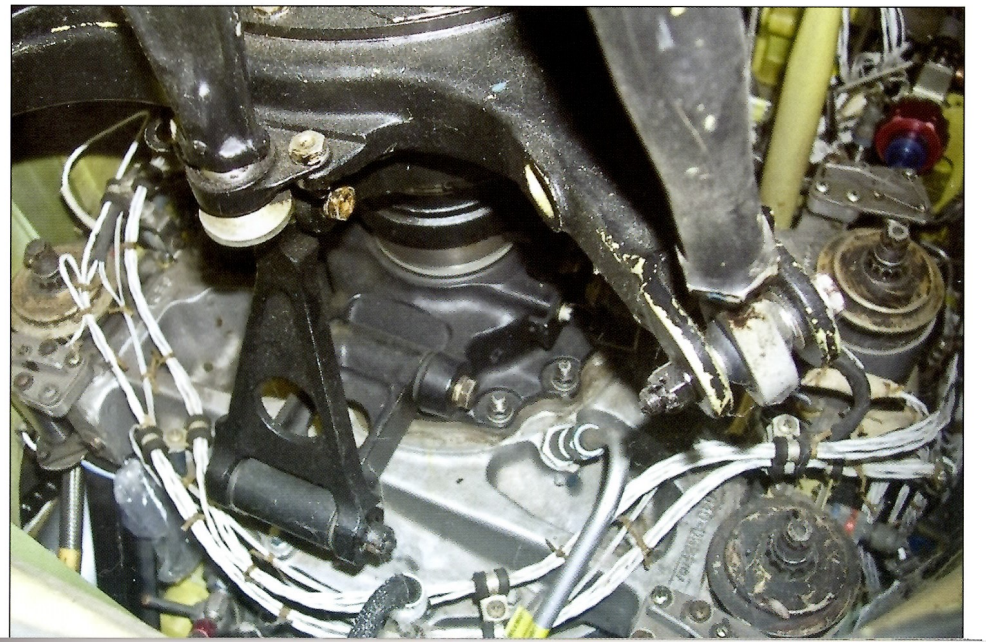
The new upper cowling was designed to deal with the extra disturbed air caused by the Mk 66 rocket motors. An access panel is under the overhang on the left side to allow the crew to check the hydraulic reservoir level. An APR-39 blade antenna is mounted on the centerline of the upper forward cowling. The upper canopies are solar gray-tinted polycarbonate to reduce glare and keep temperatures down in the cockpit.

Flying over the ocean is a key part of the Kiowa Warrior mission. This Warrior from N Troop, 4th Squadron, 2nd Air Cavalry Regiment, has the new cowling and the MPLH landing gear. It also sports both FM antennas but does not have the HF antenna housing under the tail boom.



The collective lever, attached to the control tube on the right, is above the swashplate support. The inner ring of the swashplate is above the collective lever. The outer ring, or the rotating swashplate, is outside of that. The pitch change links, which go up to the main rotor blades, are attached to the rotating swashplate. The boot on the mast is designed to keep debris out, and the drive levers are attached above the boot. These drive the swashplate with power provided through the transmission.

The base of the main rotor mast comes out of the transmission. On top of the transmission, the swashplate support provides a slide surface for the collective pitch inputs. It also provides a mounting point for the anti-drive lever and the lower mast torque sensors. The anti-drive lever secures the nonrotating part of the swashplate. The four isolation mounts on the corners of the transmission dampen the vibrations to the airframe.

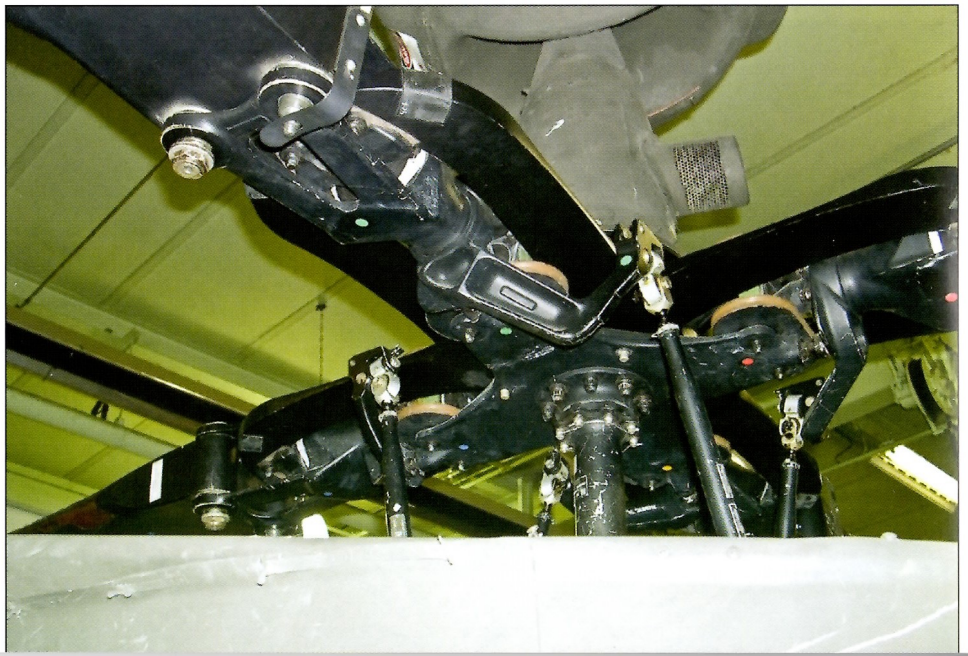


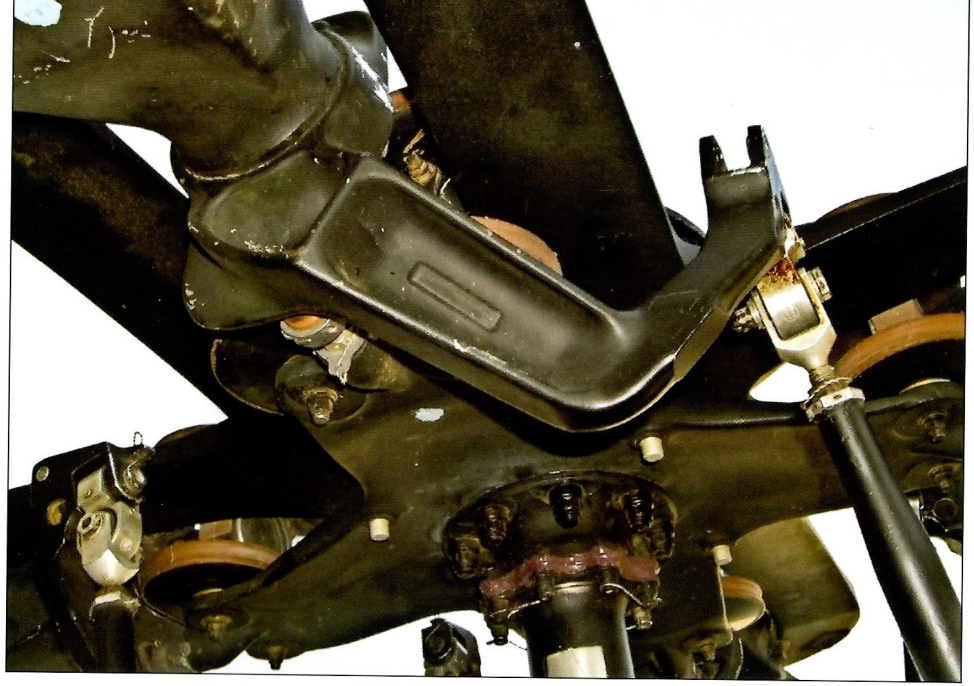
The new cowling features wraparound panels over the old cowling. The inlet is faired into the existing cowling. An APR-39 upper blade antenna is mounted in the opening.

The main rotor mast is tilted 1 degree to the left to compensate for a translating tendency. The mast is also angled forward 5 degrees to maintain a more level cabin and lessen drag in forward flight. The rotor diameter is 35 feet.

The main rotor pitch horns change the pitch in the blades with the collective or in combination with the cyclic. The main rotor hub assembly is “soft in plane,” or articulated, which allows each blade to operate independently and lead, lag, and flap within the limits of the elastomeric bearings and yoke.

Pitch change links attach to the pitch horns. The blades are attached with expandable bolts to allow the blades to be folded, and a nonexpandable bolt acts as a hinge. Not all of the expandable bolts are on the same side. The green and red blades’ expandable bolt is on the leading edge, and the orange and blue blades’ expandable bolts are on the trailing edge. The entire rotor hub assembly is painted flat black with the exception of the expandable bolts. Either two or four blades can be folded.





The pitch horn is mounted so that the pitch change link is in front of the blade by 15 degrees to properly phase the rotor system. Three types of elastomeric bearings are in the rotor system: lead-lag dampeners, inboard pitch change bearings, and outboard pitch change bearings. The lead-lag dampener is the oval orange-fringed bearing on top and bottom of the blade. The main rotor grip assembly holds the blades to the hub assembly with the expandable bolts.

The main rotor blades are composite with fiberglass skin and a Nomex honeycomb core. The blades have square blade tips with tie-down point, trim tabs, and internal balance weights. The leading edge erosion guard is a stainless steel nickel-coated strip. The rest of the leading edge is protected by Estane, a rubbery material. The erosion guard is often painted flat black to keep sand from abrading it. One coat of paint is good for a normal two-hour flight.

An E Troop, 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division, OH-58D(R) patrols the Bosnian countryside in 1998. While some of the blade movement is camera-induced, the blades do lead, lag, and flap. The MMS has touched-up paint, and the engine exhaust shield shows its distinct discoloration.

A complete blade fold requires an additional spacer, and it is only on the blue blade on the back right side.

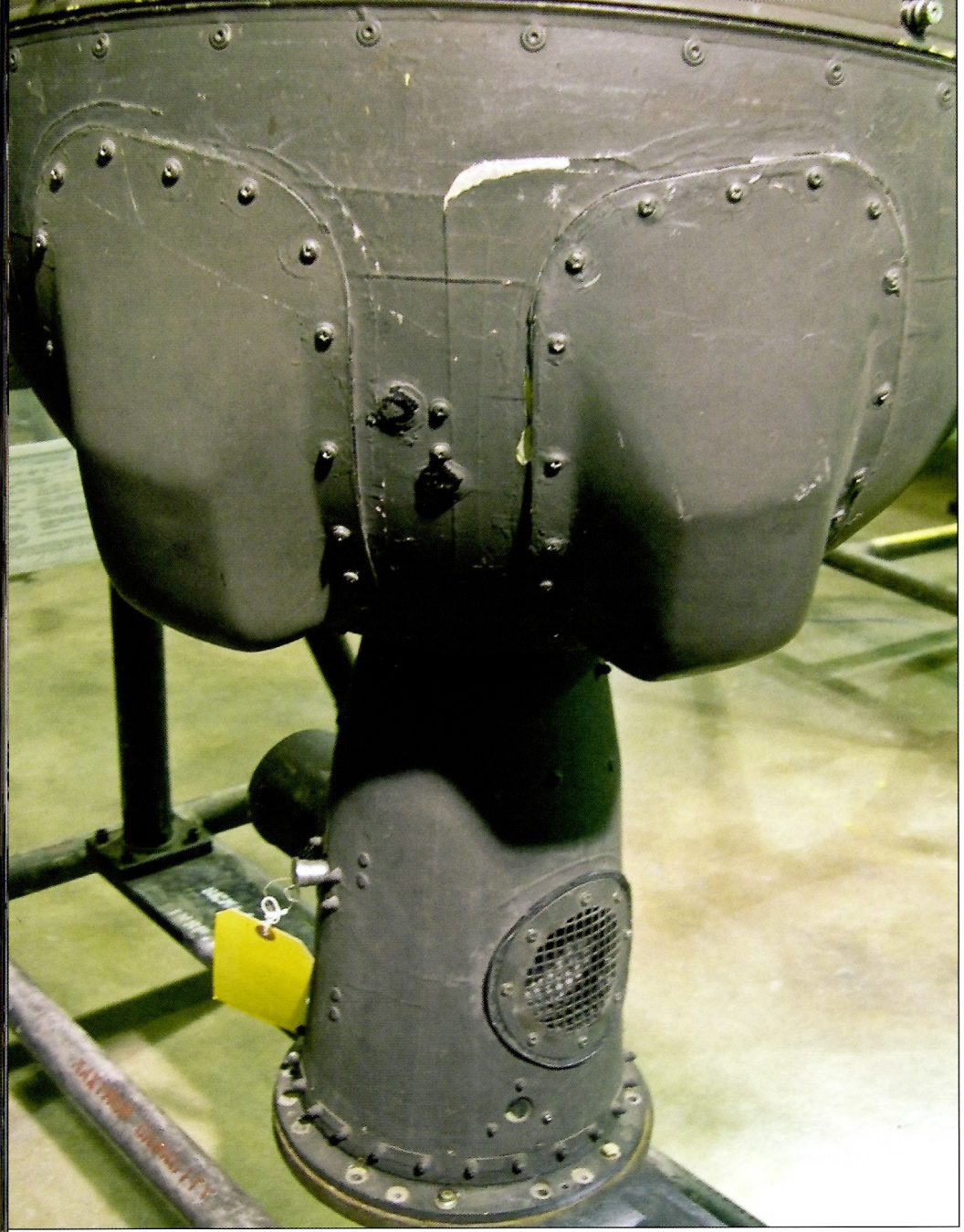
A typical two-blade fold allows more helicopters to be stored in a small area. The blade-folding kit can be red or black. The kit attaches to the tail boom by four quick-disconnect pins inserted in the holder just forward of the horizontal tail. The inside of each grip is foam-lined. The grip is opened and the blade inserted, then the hold down is pulled into place, and the blade is held securely and safely.

Operating in a dusty environment, such as at the National Training Center at Ft. Irwin, in Iraq, or in Afghanistan, causes the main rotor blades to be subjected to severe erosion and punishment. Helicopters have to deal with brownout conditions as the helicopter lands and takes off. Sand and dust are blown up into a cloud around the helicopter, sometimes causing the crew to lose sight of the ground. This can easily lead to a destroyed helicopter if it hits the ground and rolls over.

An OH-58D(R) from E Troop, 4th Squadron, 7th Cavalry Regiment, 2nd Infantry Division, scouts over a typical Korean fall countryside in October 2002.

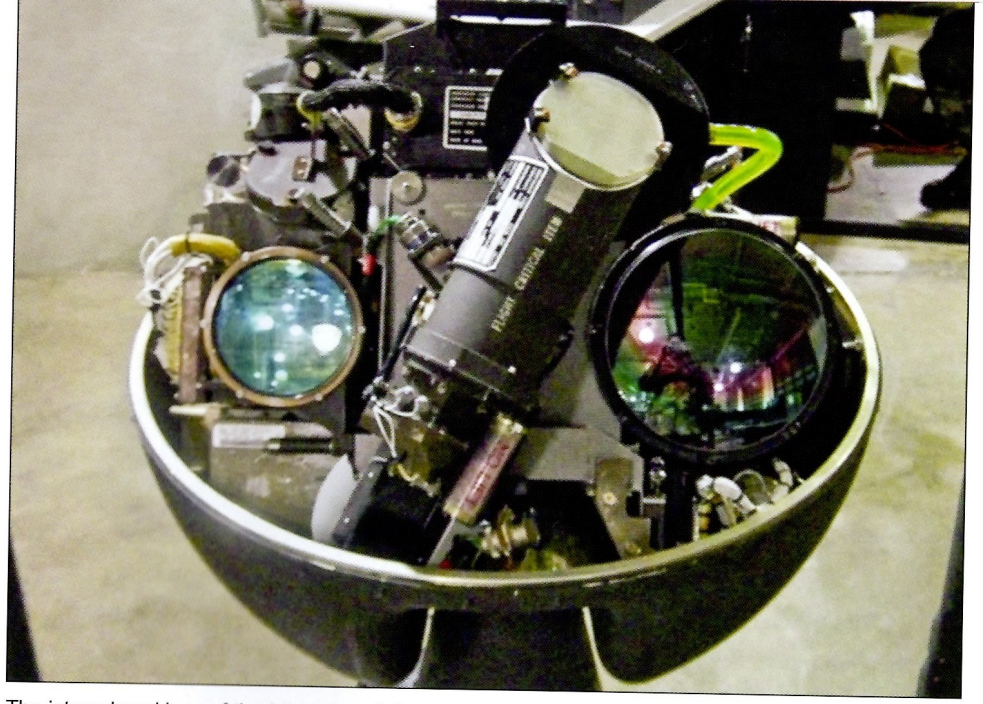
The MMS platform, the ball on top, is divided into an upper and lower shroud. These are not separated horizontally but rather at an approximately 45-degree angle to allow the lenses to be mounted in the upper shroud. The thermal conditioning unit, the screens on the base of the turret, removes heat from the sensors. The intake is the can-shaped screen, and the exhaust is a flush-mounted screen. The thermal conditioning unit contains a small radiator, fan, pump, sight gauge, and coolant reservoir. Ethylene glycol and water circulate in a closed, airtight system. A small silver servicing port cover is visible to the right of the intake screen.

The MMS provides the co-pilot/gunner with day and night target acquisition by means of a Day Low Light Television Sensor (TVS) mounted on the left in the picture and a Thermal Imagery System (TIS) mounted on the larger window in a rotating turret above the aircraft. The Laser Range Finder Designator and the boresight equipment are mounted in the turret as well. The MMS allows the aircraft to hide behind cover and see over it. The turret assembly is the center post shroud. It is painted in the same low-reflectance paint as the aircraft.



The bulges on the back of the lower shroud provide space for two electromagnets, which help stabilize the MMS picture, especially in the narrow field of view. The MMS can rotate 190 degrees in azimuth and +30 degrees in elevation. The upper shroud is held on by captive bolts.

To remove the MMS, a large red bag is attached with Velcro and the platform assembly is removed from the mast by a crane or jib hoist. It is then lowered onto the maintenance stand. The internal MMS components can be removed while the MMS is on the helicopter by using the built-in maintenance stand. When the platform needs work, it becomes necessary to remove the whole assembly. It is also removed for shipment by a C-130.

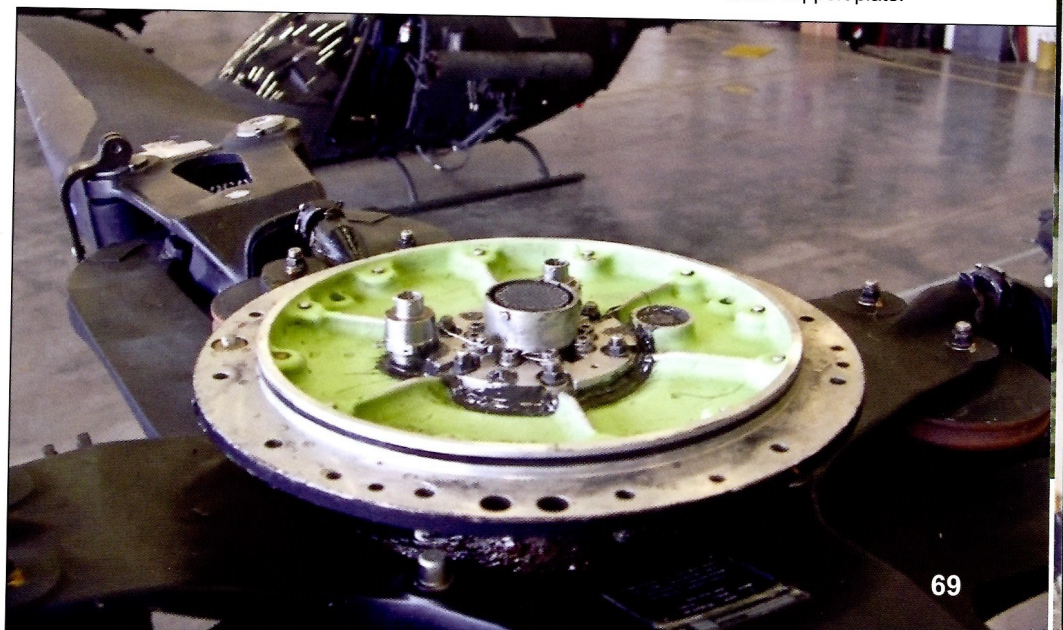


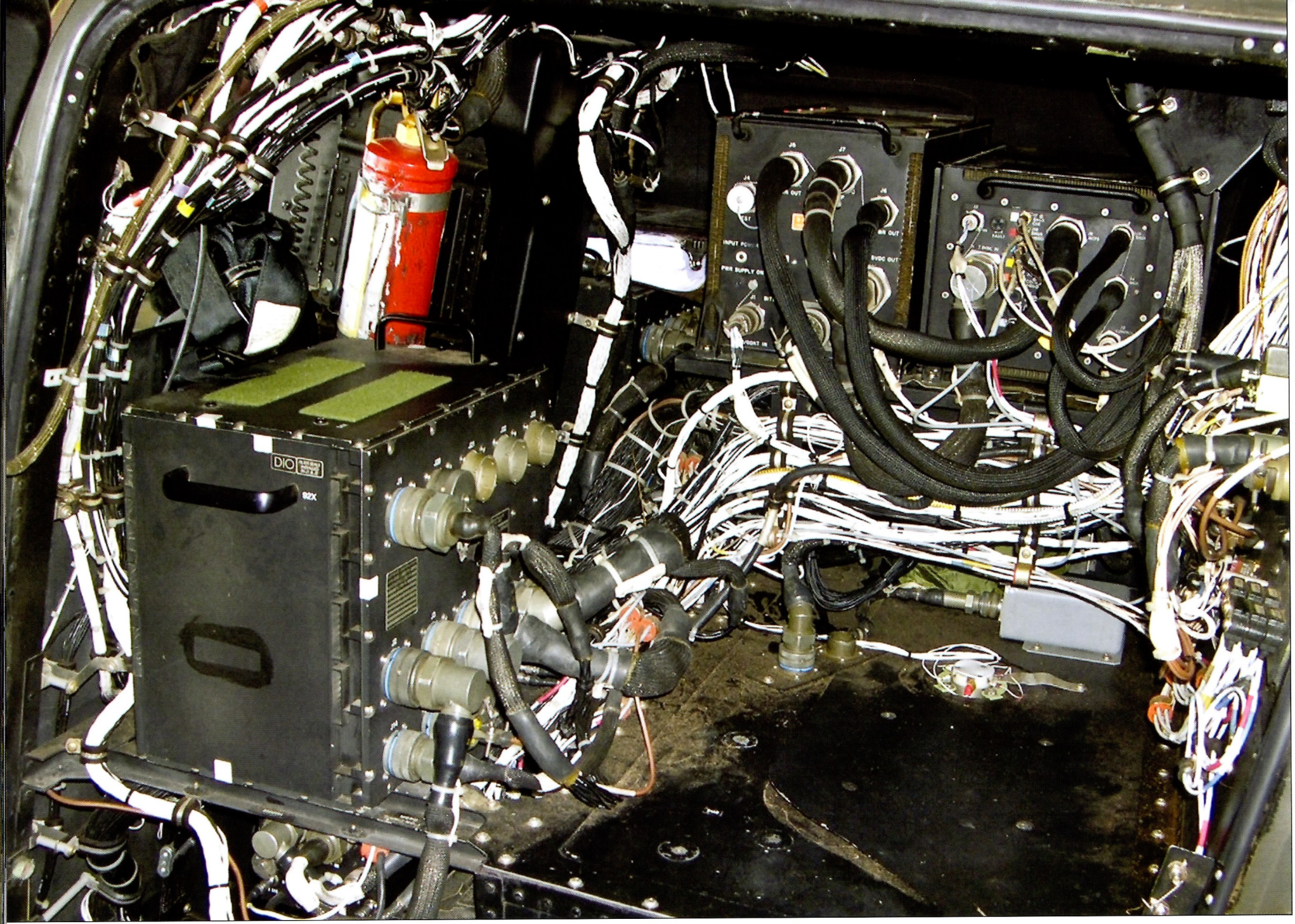
The internal workings of the MMS, from left, are the TVS, with the blue-tinted lens; the optical boresight assembly, the cylindrical component in front of the TVS; and the TIS. On top center is the laser range finder. (*William Roberts*)

Occasionally, the helicopter must be flown with the MMS removed for maintenance. On these occasions, the MMS support plate is covered by a blanking plate. The blanking plate covers the connectors and keeps debris out. (*Erick Swanberg*)

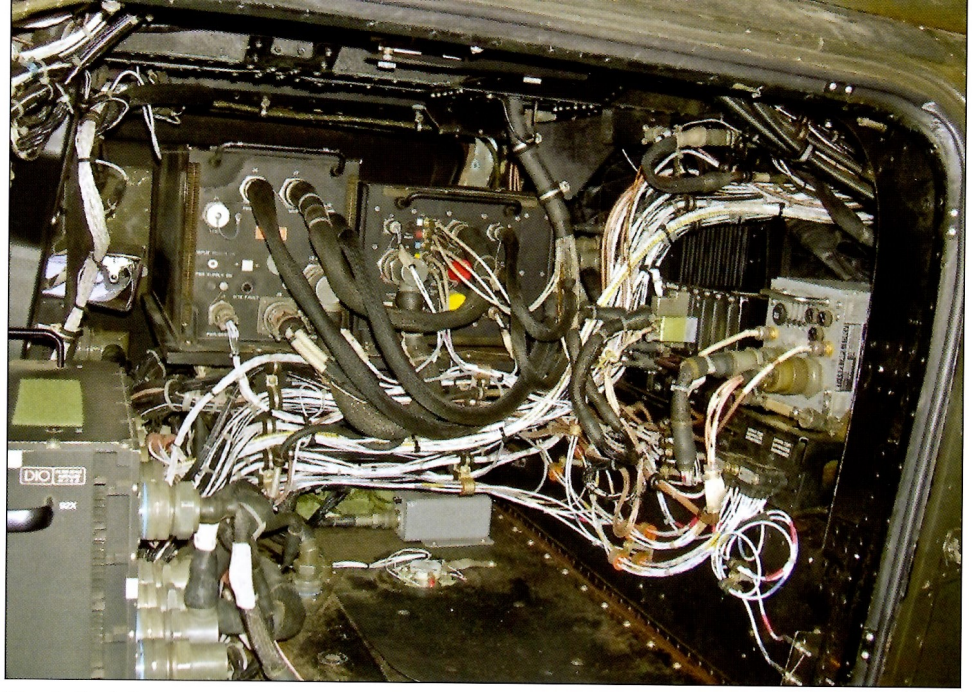
A C Troop, 2nd Squadron, 17th Cavalry Regiment, 101st Air Assault Division, Warrior flies over the Iraqi desert en route to Kuwait in January 2004. With the MMS removed, the Kiowa Warrior resembles its predecessor, the OH-58A/C. The armament systems can be operated without the MMS, but the crew must rely on the grease-pencil-on-the-window method. An aircraft without the MMS can shoot Hellfire missiles for another aircraft as long as the laser codes are correct.

The Mast Torque System is under the MMS. The Mast Torque System measures the main rotor mast torque by using torsional twist. One torque sensor is mounted on the support plate (the silver connector on the left), and another is attached to the bottom of the mast. These readings are averaged, and the information is fed to the IMCPUs. The power cable connector for the MMS is in the center of the support plate.



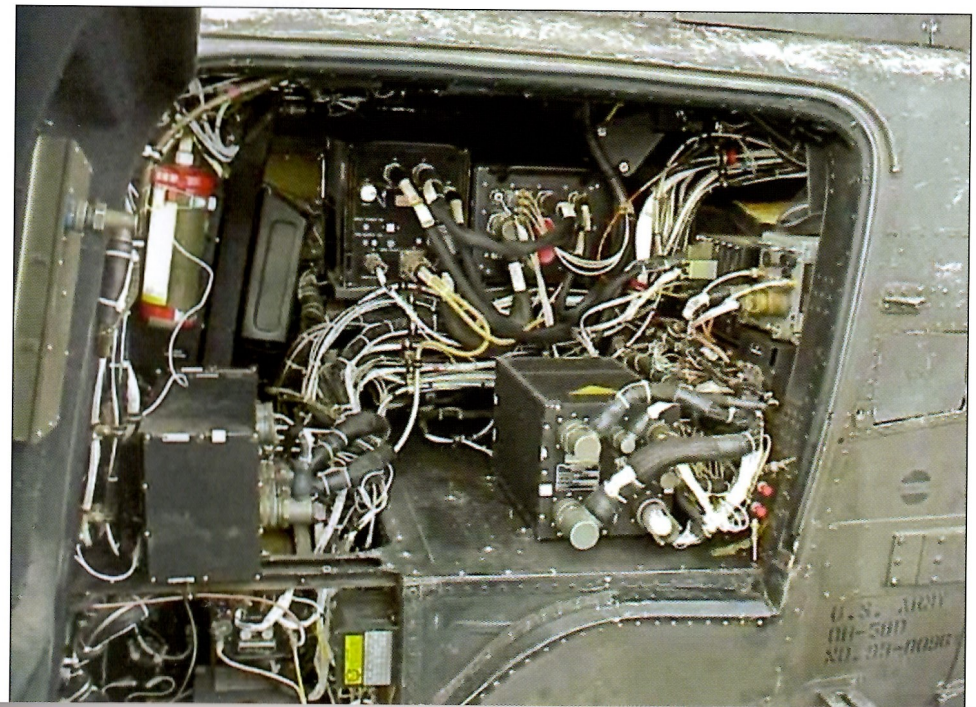


The back seat of an OH-58D(R) has the IMCPU on the left, the MCPS in the center, and the MSP on the right. The large open area is often used to carry survival kits and personal gear.

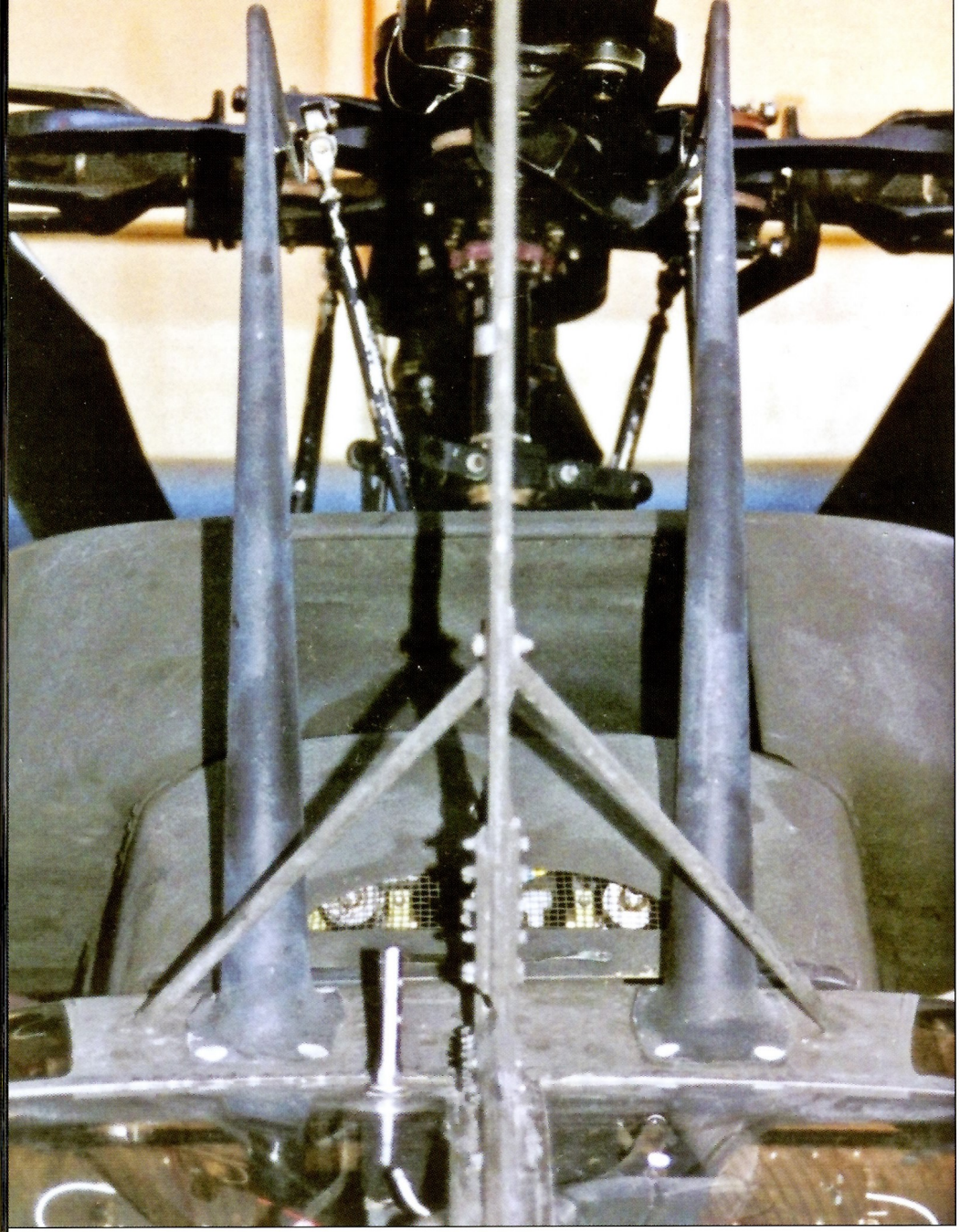


Clearly, the left rear compartment has no room for passengers, only black boxes for the aircraft. The gray box on the right side by the door is the Kit-1A IFF.

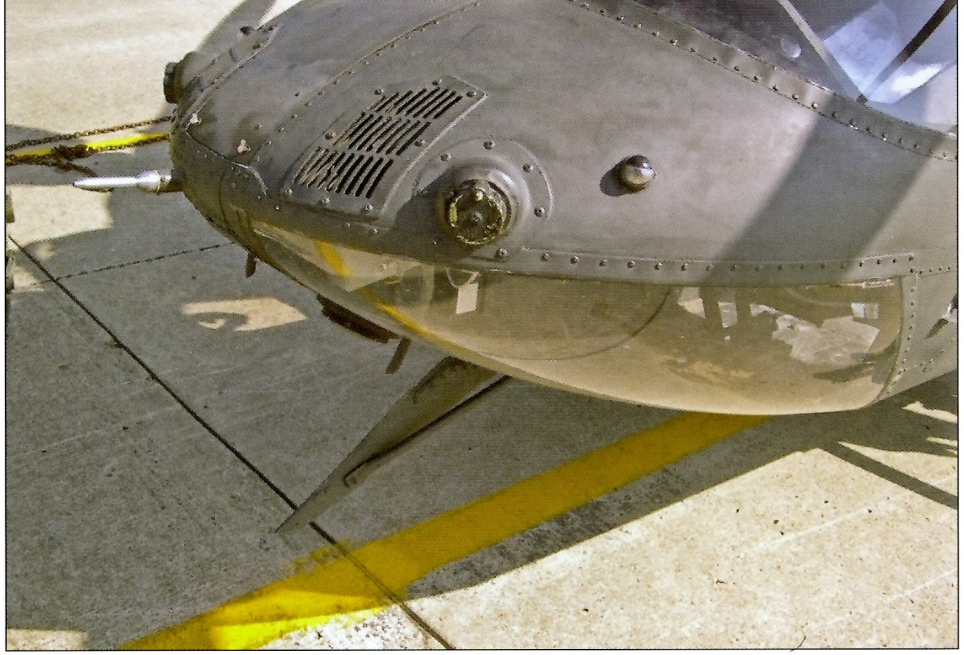
The back seat of an early Warrior, probably an OH-58D(I), has additional black boxes, including the ISP, which is to the rear of the opening. The MCPU is noticeably smaller than the newer version, which has more capability. With the newer hardware in the OH-58D(R), the IMCPUs have more features than the older black boxes, which have been eliminated to save weight.



With the addition of the CABS, the first aid kit had to be moved to the left rear door. A second cooling vent was added in 2005 to help cool the equipment in the back. The AVR-2 antenna is in its mount. This aircraft survivability equipment is frequently removed in Iraq, where laser-guided munitions are not a threat.

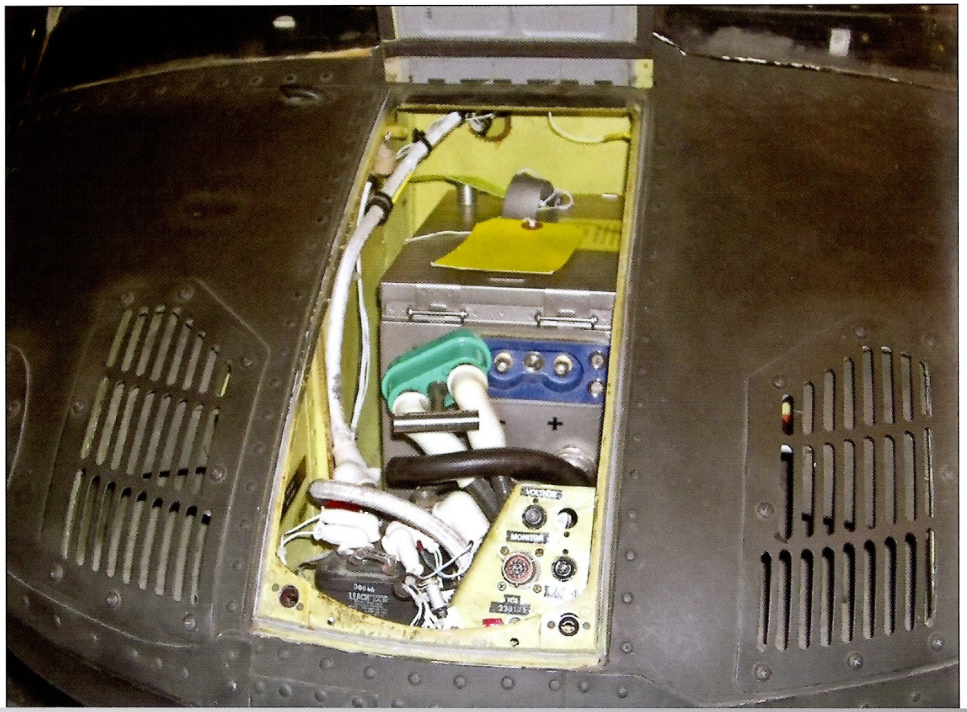


The upper WSPS is mounted on the upper nose to protect the rotor system. Two FM antennas are directly behind the WSPS. The ends of the antennas are normally bent up to allow the upper cowling to be taken off more easily. The antennas are painted flat black and sometimes have white numbers on them. The white numbers are Bell Helicopter production numbers and do not correspond to the tail number. The silver probe under the WSPS is the free air temperature gauge.



The forward section of the Warrior houses the APR-39 antennas, infrared lights, and vents for the cockpit and battery. Near the door frame is the static port, which, in conjunction with the pitot tube extending from the front of the helicopter, provides air for instruments such as the airspeed indicator and altimeter. Below the nose are the lower WSPS and the search/infrared light.

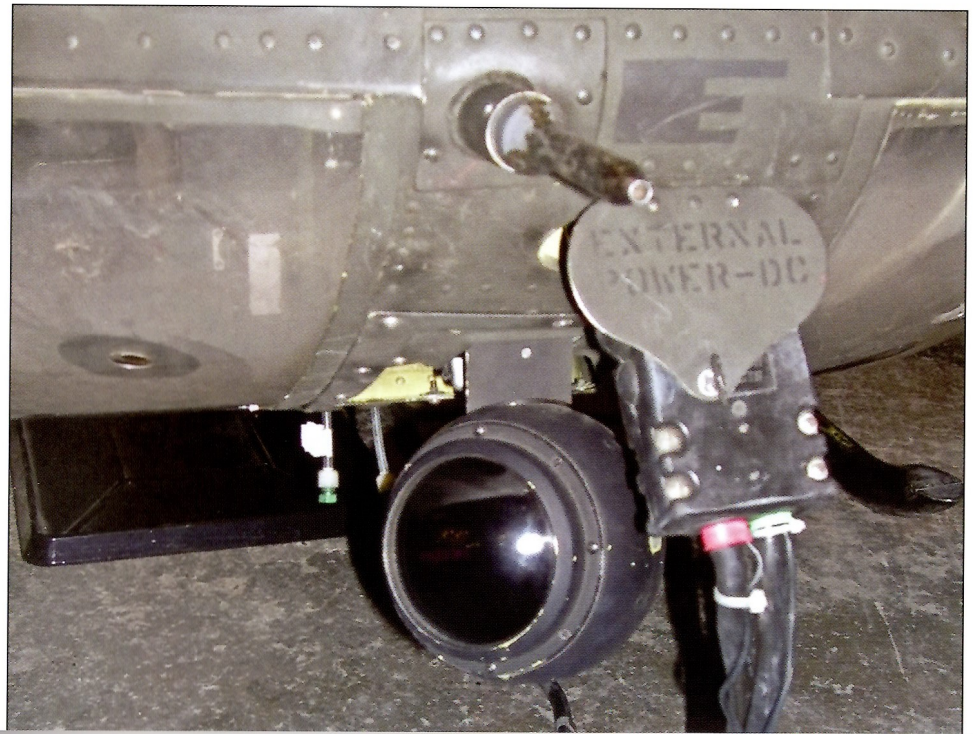
The forward battery compartment provides a mount for the airframe 24V battery. When not in use, the battery is disconnected. Cooling vents are on both sides of the battery compartment. The compartment door is held shut by two Dzus fasteners.



At the height of a dust storm at midday, the sun is blocked out and the Iraqi desert looks like Mars. Flying is impossible during this time, so catching up on some sleep in a tent while someone does guard duty is the only thing to do. The crew is going to have a hard time getting all the sand out of the helicopter since the doors were left off. Multipurpose submunition rockets are in the rocket pod. (*Mark Vanderweyden*)

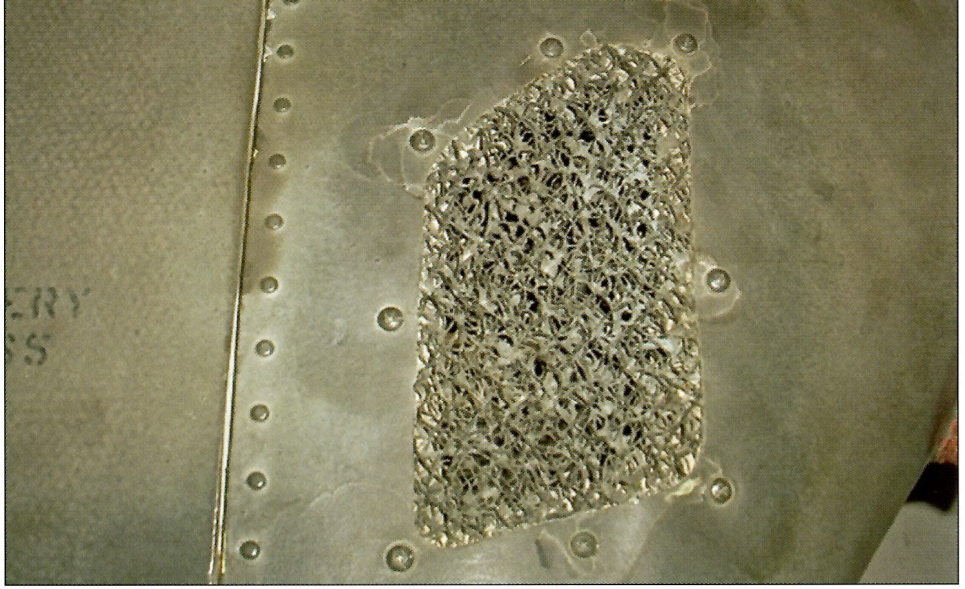
The lower nose holds the lower WSPS. Drain lines from the vent compartments extend out of each chin bubble. The searchlight rotates 360 degrees and has a normal landing light on one side and an infrared landing light on the other. Besides rotating, the light can extend forward, allowing the pilot to move the light to where he or she wants to see.

The infrared searchlight under the nose of the Warrior has a dark lens. This light is invisible to the naked eye but is bright under NVGs. The external DC power receptacle has an external electrical power source attached. The white tubes behind the light are drain lines for the pitot-static system.



The Kiowa Warrior is an asset in the cavalry mission. Hovering above an M2A2 Bradley and an M1A2E3 Abrams tank, this Kiowa Warrior from the 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division at Ft. Hood, Texas, demonstrates the close cooperation between air and ground cavalry.

A stealth Kiowa Warrior flies over an oil fire in Iraq. The stealth Warriors have continued to serve in a variety of units since they were built and can be detected by their pointed noses.



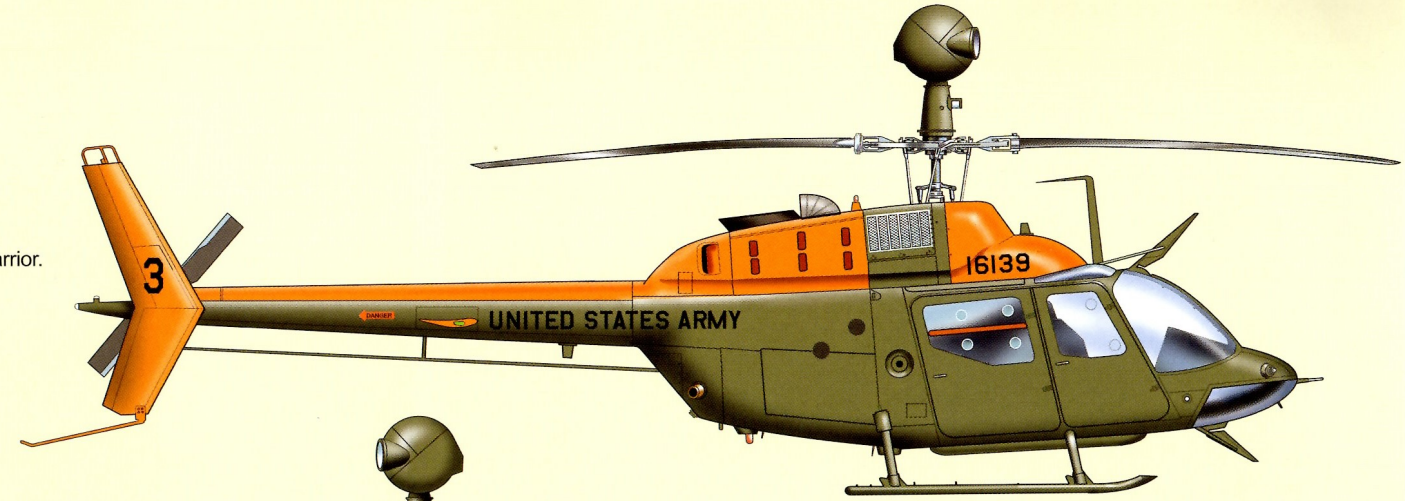
A slurry of material covers vent intakes and is designed to deflect radar waves. The battery compartment door has radar-absorbing material built up to the contours of the nose section. (*George Prosnik*)

The underside of the stealth nose shows how much it was changed. It was lengthened with radar-absorbing material. The main rotor shrouds were not used on operational aircraft, and the stealth technology was transferred to the now-canceled Comanche program. The infrared light is extended. (*George Prosnik*)

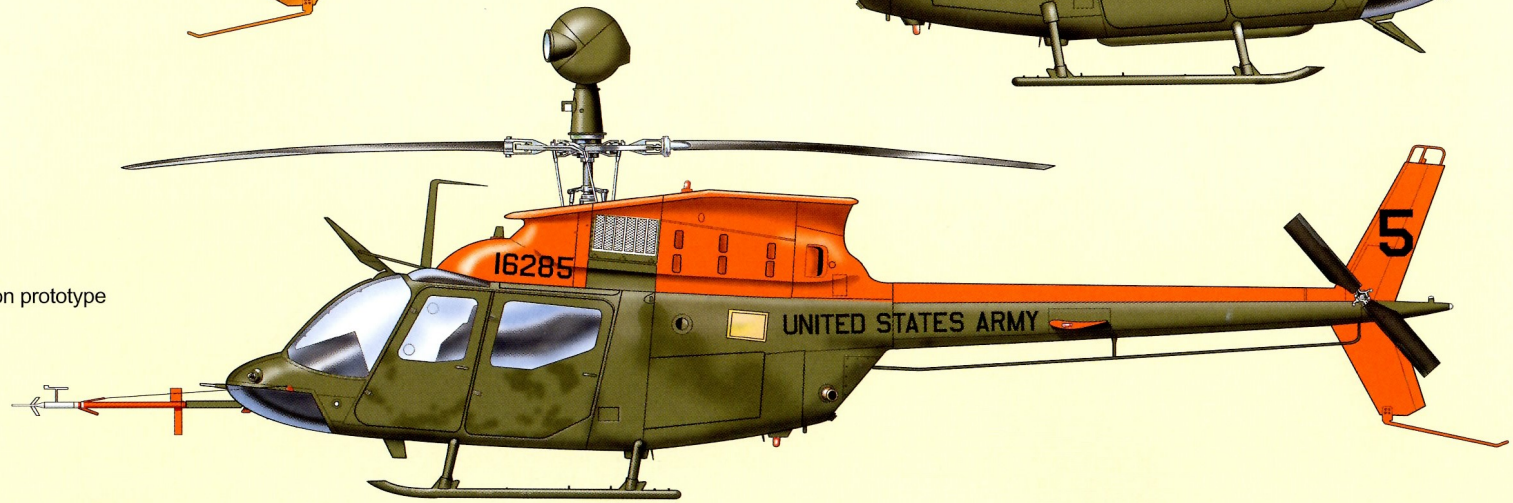
Stealth modification introduced a slope to the nose of the Warrior. A static port is in front of the door, but the pitot tube is under the nose on the stealth aircraft. The searchlight is extended, and the lower WSPS is mounted as it would be on a normal aircraft. (*George Prosnik*)

A U.S. Army OH-58D with the 4th Squadron, 7th Cavalry Regiment, hovers over the treetops as it prepares to support armor during maneuvers and gunnery training at the Korea Training Center on 25 October 1998. (*Tech. Sgt. James D. Mossman*)

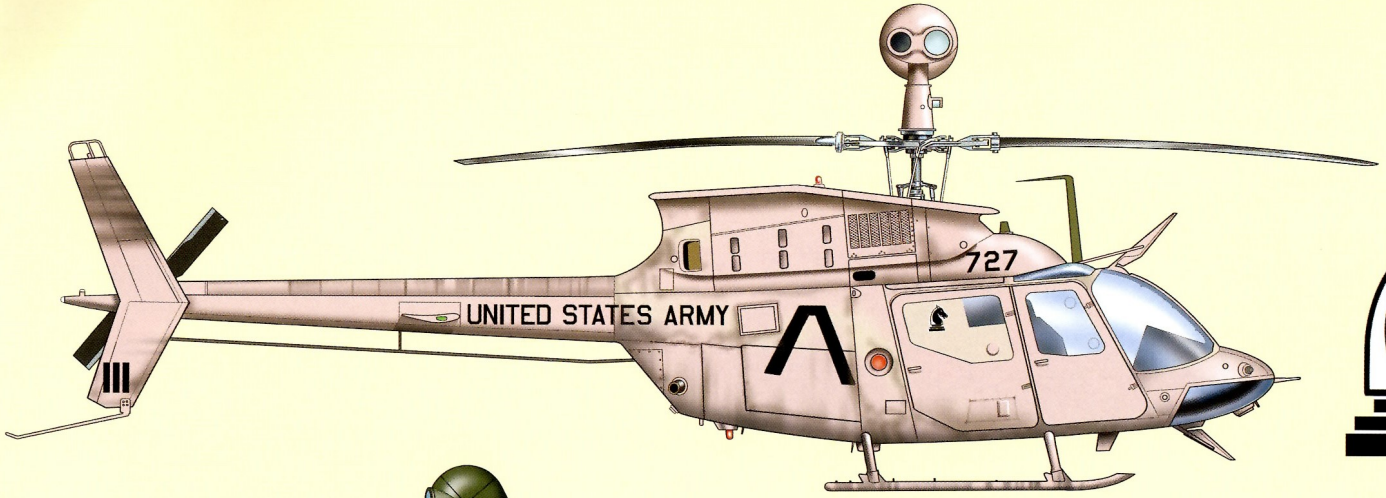
Aircraft No. 16139 was the third prototype for the Kiowa Warrior.



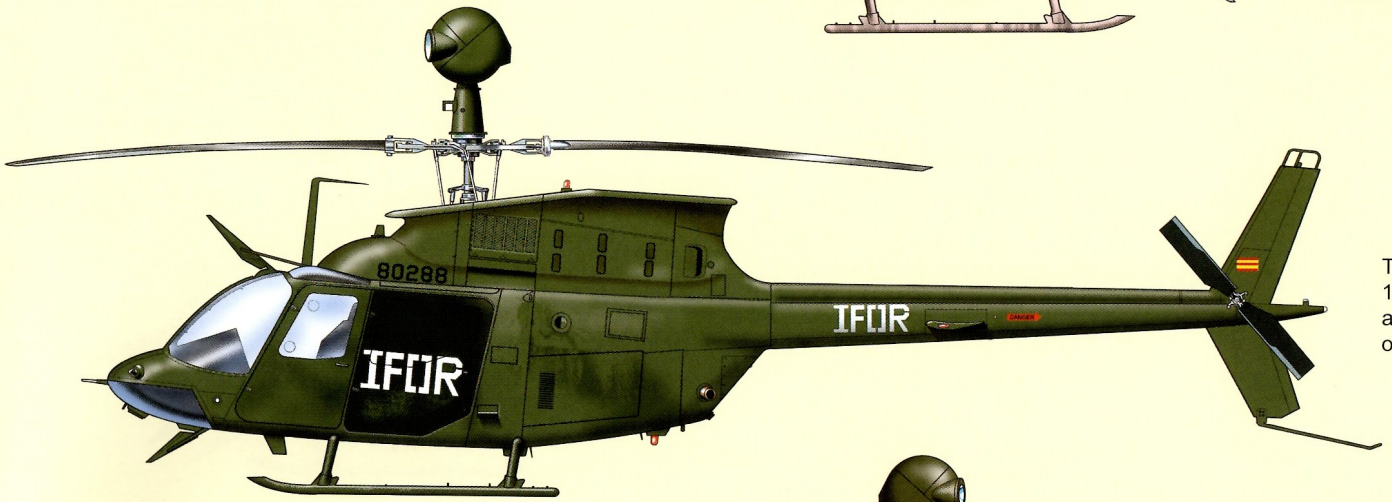
This helicopter was the final preproduction prototype for the Kiowa Warrior.



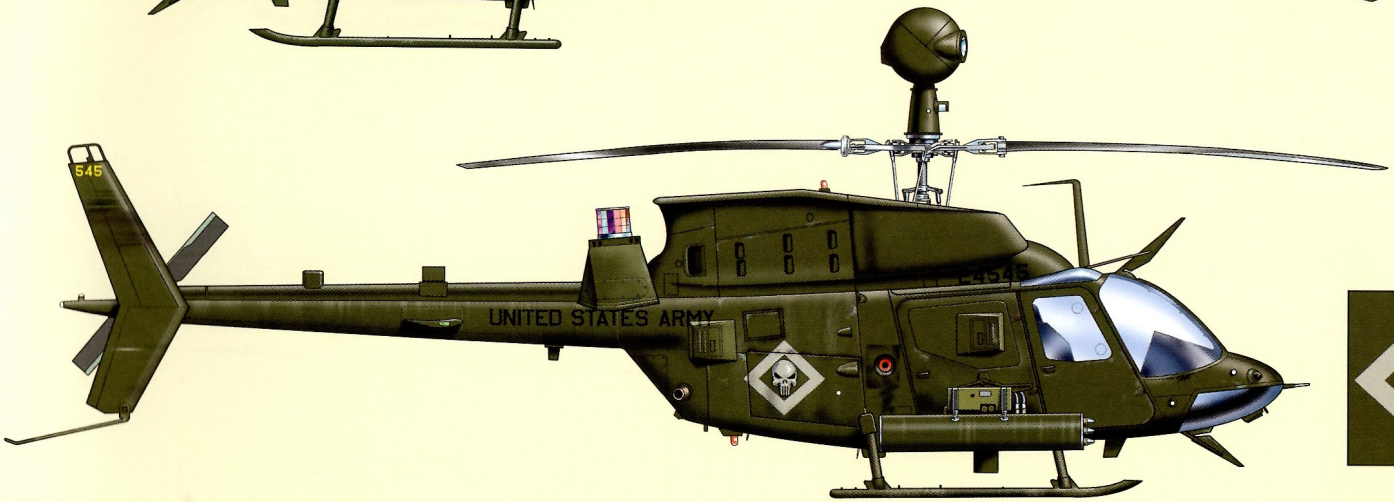
Bell Helicopter's demonstration OH-58D was painted in a gloss black paint scheme complete with a Kiowa warrior Indian head.



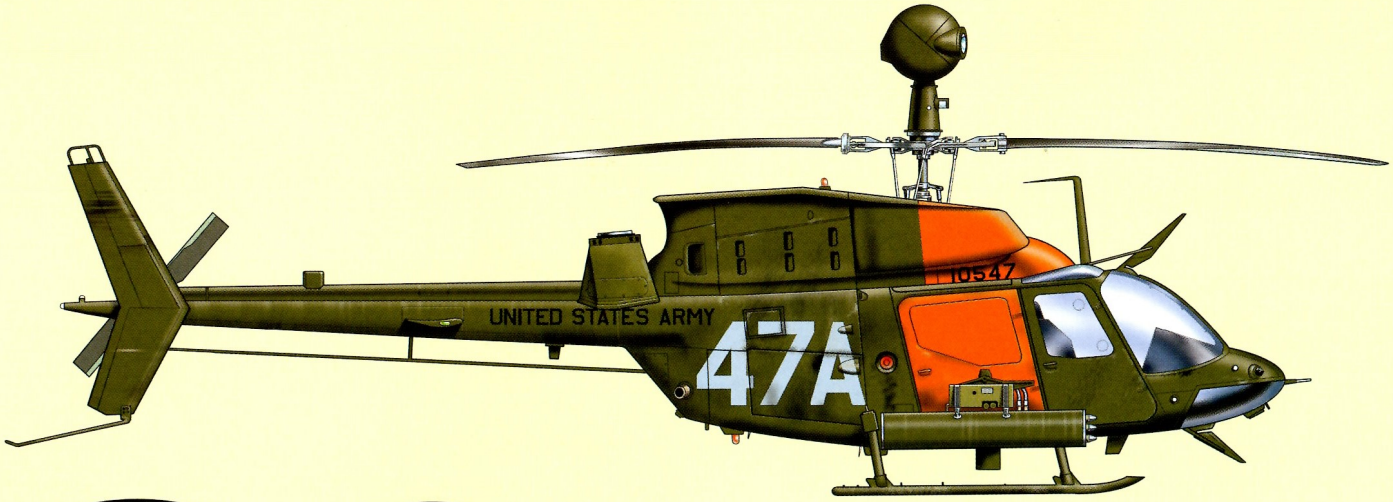
This aircraft was assigned to H Company, 4th Brigade, 3rd Aviation Regiment, 3rd Infantry Division during Desert Storm in 1991.



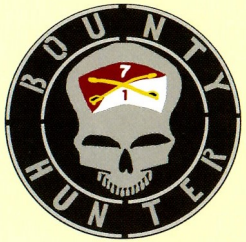
This aircraft was assigned to D Troop, 1st Squadron, 1st Cavalry Regiment, 1st Armored Division based at Kaposvar, Hungary, in December 1995 as part of the Implementation Force (IFOR).

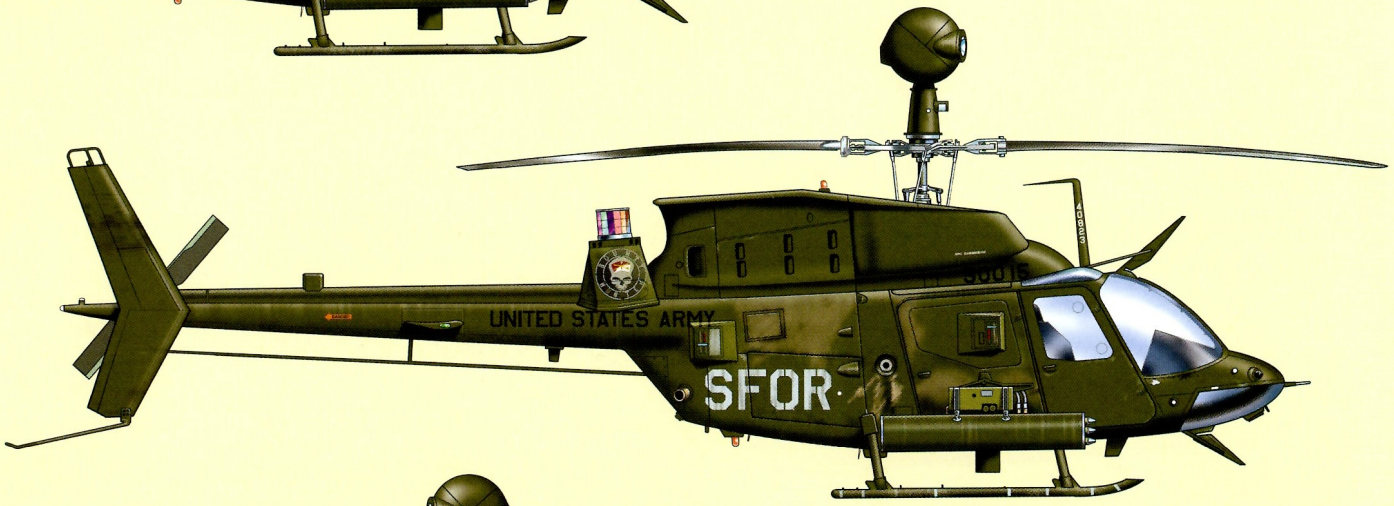


This Warrior has a “Punisher” skull marking inside a diamond tactical marking.



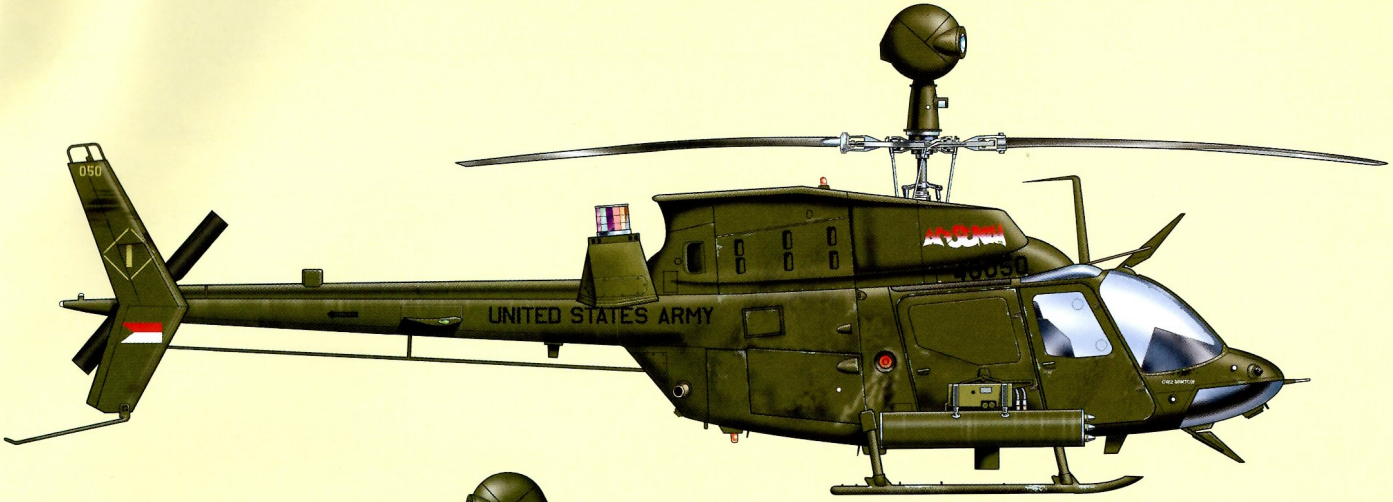
This OH-58D was assigned to Ft. Rucker, Alabama, the home of Army Aviation.





This OH-58D(R) was assigned to E Troop, 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division, in Bosnia in 1998 as part of SFOR. A 1st Cavalry emblem is on the nose of the Warrior. The "Bounty Hunter" emblem of E Troop is on the right side of the ALQ-144 pedestal, and the "Garryowen" crest is on the left.

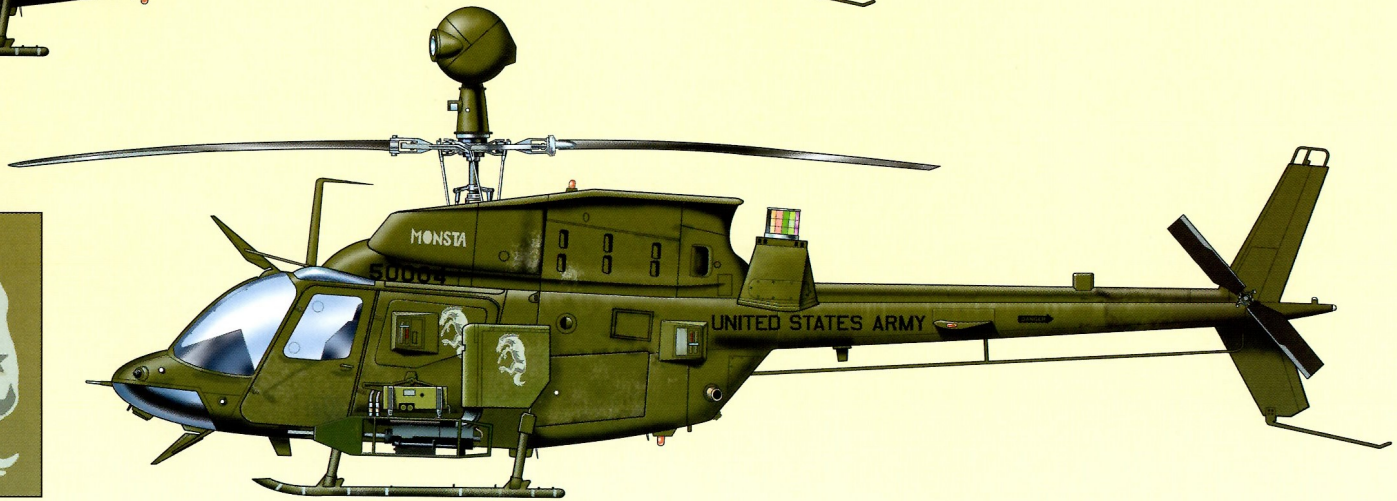
Taiwan is the only country besides the United States to fly the OH-58D Kiowa Warrior.



This OH-58D was assigned to 2nd Squadron, 17th Cavalry Regiment, 101st Airborne Division. Its nickname, "Arsenal," was painted on both sides of the upper cowling.

This OH-58D was assigned to D Troop, 1st Squadron, 4th Cavalry Regiment in Kosovo.

"Monsta" has a bucking bronco painted on the .50-caliber ammunition box and on the back door.



An E Troop, 1st Squadron, 7th Cavalry Regiment, 1st Cavalry Division, Warrior flies over the Bosnian countryside in 1998 as part of the SFOR. Rapid worldwide deployment is a hallmark for the Kiowa Warrior. (*Bell Helicopter*)

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